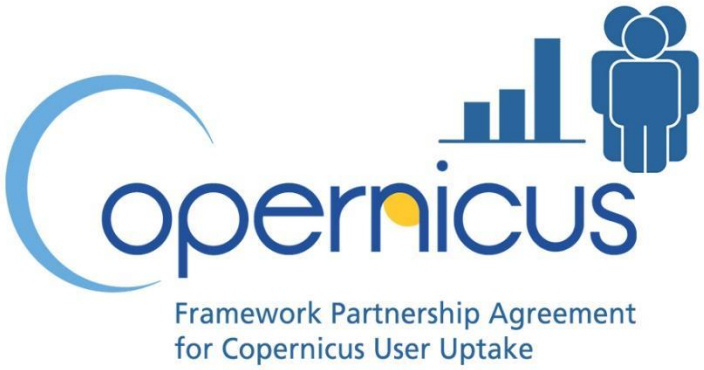

FPCUP ACTION 2021-2-42:

COPERNICUS UPTAKE FOR THE MARITIME SECTOR

WP1) Awareness, assessment of needs and training

M02: Report on user needs and requirements for the 3 sectors:

- Ports and harbours
- Aquaculture
- Fisheries

Executive Summary

The Copernicus program provides reliable global data, which can be used to address challenges and promote a balance between profitability, environmental sustainability, and growth in specific industries, such as the maritime. FPCUP Action A2021-2-42 aims to foster collaboration among stakeholders and enhance the use of Copernicus data and products in three maritime sectors: Ports and Harbours, Aquaculture, and Fisheries. This report contributes to fulfilling M02 of Work Package 1 (WP1) by presenting the survey results, which were designed to gather the needs, gaps, and requirements for each sub-sector and to gain a better understanding of current Copernicus data usage.

The survey, conducted in four languages (FR, SP, EN, PT), was disseminated to approximately 600 stakeholders across various countries and regions, including Cyprus, France, Portugal, Spain, and selected non-European countries. A total of 123 responses were received from EU countries, and 49 from non-EU countries, providing insights into the needs and requirements of stakeholders from both European maritime sectors and beyond. The survey showed active involvement from research-related organisations, academia, and public administrations, with limited participation from private entities. While responses were evenly distributed among the three sectors, variations in preferences were observed among countries, indicating regional differences in priorities and sector-specific needs.

The survey was completed satisfactorily, and the results provide a foundation for the continuation of the action and the implementation of dedicated training (M03: Awareness and local training events). Key findings from the survey revealed that, while there is a high awareness of the Copernicus program, only half of the stakeholders currently use the data. The other half, non-users, mentioned a lack of knowledge or skills as the primary barrier to data utilisation, highlighting the potential for further adoption. Stakeholders with intermediate to advanced skills reported regular and frequent use of Copernicus data, while a quarter of users had basic knowledge. The survey also found a balanced use of satellite data and models, with in-situ data playing a minor role. There is a demand for improved data accessibility, availability, coverage, and increased spatial resolution. These findings suggest that a comprehensive approach, involving multiple actions, is necessary to enhance user satisfaction. Overall, stakeholders expressed a positive level of satisfaction with Copernicus data, indicating the program's success and room for improvement.

This training will consider the needs and gaps identified in the survey and will make a specific effort to engage with private sector users to ensure their views and needs are properly considered.

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Background

The marine sector faces several challenges regarding management and sustainability. It is becoming evident that these challenges are even more noticeable during the implementation of certain policies and strategies. Users from maritime sectors need more information to characterise bathymetry changes, to maintain infrastructures and to determine the environmental status of waters (e.g., water quality, sea state). This info helps to address the challenge of maintaining a balance between profitability and environmental sustainability and growth.

The Copernicus program is dedicated to deliver global data in a reliable and sustainable way. Numerous nations encounter difficulties in ensuring sustainable growth in specific industries, and this Framework Partnership Agreement for Copernicus User Uptake (FPCUP) action centres on leveraging Copernicus data for the maritime sector, particularly Ports and Harbours, Aquaculture, and Fisheries.

With the growing demand for global trade and maritime transport, *ports and harbours* play a main role in facilitating international trade. Maintaining a profitable and sustainable balance is crucial to their long-term success. Here, satellite data appears as an ally, serving as a tool to identify suitable port development areas, monitor facilities and assess environmental impacts. Moreover, it is proving to be especially relevant in port management, allowing the establishment of early warning systems for critical parameters such as water quality, environmental pollution, and coastal erosion.

With the ongoing rise in seafood demand and limited capacity to expand wild fishery catches, *aquaculture* has become one of the fastest-growing sectors in the global food industry. However, maintaining a profitable and environmentally sustainable balance is crucial. Satellite data plays a vital role in this regard, serving as a valuable tool to identify suitable farming areas and assess environmental impacts. Additionally, it is highly relevant for daily aquaculture management, enabling the establishment of early warning alerts for various water quality parameters, including chemical, physical, and biological factors such as Harmful Algae Blooms.

The fisheries sector is another significant component of the maritime industry, offering uptake potential for increased utilisation of Copernicus in fishing operations. This includes the ability to identify areas of higher productivity and utilise sea state maps for safer operations. Moreover, Copernicus can play a crucial role in supporting local and national authorities in detecting illegal activities within the fisheries domain.

While each maritime sub-sector mentioned above may have unique data processing requirements or specific analysis needs, there are also shared information requirements such as water quality assessment and sea state prediction.

The FPCUP aims at a better integration of Copernicus data in the European regulatory framework by increasing the number of users and applications derived from Copernicus through different actions. This report regards *Action A2021-2-42* that pursues "to promote the use of Copernicus data across the maritime sector, focusing on Ports and Harbours, Aquaculture and Fisheries".

The overall objective of this action is to foster collaboration with stakeholders from these three sectors, including public entities responsible for sector management at various levels, ranging from local to regional authorities, as well as companies whose primary operations are linked to any of the sub-sectors.

To address the specific needs of these users and enhance the uptake of Copernicus across the maritime sector, this action includes 3 lines of activities/Work packages (WP):

WP1) *Awareness, assessment of needs and training*: to showcase Copernicus capabilities and gather needs and requirements for each of the sub-sectors mentioned above in different regions (Atlantic, Pacific, North Sea, and Mediterranean Sea). Considering those needs and requirements, organise training sessions to local authorities and stakeholders to use Copernicus data in cooperation with local partners. The Milestones are:

- M01 Survey design and dissemination in 4 languages (EN, ES, FR and PT),
- M02 Report on user needs and requirements for the 3 sectors based on the survey replies,
- M03 Awareness and local training events.

WP2) *Promotion of dedicated match-making events/platform*: for networking between service providers using Copernicus data and the maritime sector end-users, promoting match-making events between stakeholders and service developers to foster business. The Milestones are:

- M04 Database on service providers per sector,
- M05 Report on the match-making event,

WP3) *Catalogue of use cases for the maritime sector*: use cases for each sector to be compiled and included in a catalogue to be translated and distributed in four languages (EN, ES, FR and PT). The Milestones are:

- M06 Catalogue and final presentation event.

These activities address, not only European stakeholders (from the different countries of the consortium partners) but will also focus on other regions where

these sectors are very relevant and hold a high potential to increase Copernicus uptake. Benefiting from the network of consortium partners and the participation of some partners in actions 2021-2-31 (South America) and 2021-2-39 (Africa), activities will also be conducted in at least two countries in South America and two countries in Africa.

1. Introduction

This report is the contribution to fulfil M02 (*Report on user needs and requirements for the 3 sectors*) of Work Package 1 (WP1) within action 2021-2-42: Copernicus uptake for the maritime sector (see Background section).

This document reports the results of the survey launched within M01 (Survey translated in 4 languages), distributed through Portuguese, Spanish, French, Cypriot stakeholders.

The Portuguese participation was led by the AD Atlantic International Research Centre (AD AIR Centre), with the support of the Portuguese Space Agency (PT Space). AD AIR Centre was responsible for the survey dissemination to non-European stakeholders (South America, Africa).

The Spanish participation was led by the Instituto de Hidráulica de Cantabria (IHCantabria), with the support of the National Institute of Aerospace technology (INTA).

The French participation was led by the Centre National d'Etudes Spatiales (CNES) with the support of Pole Mér Bretagne Atlantique (PMBA).

The Cypriot participation was led by the Cyprus University of Technology (CUT).

2. Objective

The objective of the survey was to identify the current needs and gaps of the stakeholders to better understand the current usage of Copernicus data across different maritime sectors, focusing on Ports and Harbours, Aquaculture and Fisheries.

3. Methods

The survey was compiled from contributions, by the different partners, and a final English version with 34 questions was agreed upon (Annex I). It is noted that this action is being coordinated with other actions, part of Working Group Oceans, namely, Action 2021-2-33[1] (Copernicus for Marine Spatial Planning and

[1] https://www.copernicus-user-uptake.eu/user-uptake/details/copernicus-for-marine-spatial-planning-and-eu-directives-518

EU Directives) and Action 2021-2-47[2] (Coastal coordination of user needs and methodologies), and, therefore, the survey included questions that contributed to all three actions, to improve efficiency and avoid stakeholder fatigue.

The final survey was then translated to the different languages of the participating countries for dissemination.

Survey questions were organised in the following sections:

- GENERAL INFORMATION (Q.1)
- MARINE SECTORS (Q2-Q13)
- MARINE SECTOR & MSP GAPS (Q14-Q16)
- EU MARINE DIRECTIVES (Q17-Q23)
- MARINE STRATEGY FRAMEWORK DIRECTIVE GAPS (Q24-Q27)
- COPERNICUS (Q28- Q34)

The present analysis covers the results applicable to **Action 2021-2-42**, therefore only the replies corresponding to the following questions are considered in this report:

- GENERAL INFORMATION (Q.1)
- MARINE SECTORS (Q2-Q13)
- MARINE SECTOR & MSP GAPS (Q14-Q16, i.e., regarding data needs)
- COPERNICUS (Q28- Q34)

The identification of stakeholders and dissemination of the survey was done independently by each partner leveraging contacts, partners, previous email campaigns, social media outreach, as well as personalised invitations to encourage participation. The objective was to gather diverse perspectives, maximise participation and enrich the outcome of the project.

For the Portuguese survey, stakeholders were identified among the list of contacts, from the Portuguese Space Agency and the AIR Centre, targeting Portuguese institutions, academia, private sector, and national Copernicus users. The total number of stakeholders listed was 104, who were contacted by email (general mailing list and individual email reminders).

For the Spanish survey, a list of relevant stakeholders was identified by IHCantabria and completed by INTA. The list was derived from previous projects and events related with the marine sector and MSP, and completed with sources, including:

- contributors to marine/oceanography sessions in recent Spanish national remote sensing congress and workshops,

[2] https://www.copernicus-user-uptake.eu/user-uptake/details/coastal-coordination-of-user-needs-and-methodologies-516

- Spanish groups participating in Horizon 2020 and Horizon Europe projects related to the action goals,
- institutions participating in the Spanish Copernicus User Forum.

The total number of stakeholders listed, including the 3 FPCUP actions, was 350.

The Spanish survey was disseminated online through the IHCantabria web page. Potential stakeholders were individually addressed, but also a broad distribution of the survey link was done through relevant mailing lists and social media.

For the French survey, the list of stakeholders identified was more limited but amounted to around 100 stakeholders. This list was built up over the years in relation to the various projects in the maritime field and comes from the cross-database CNES / Pole Mer Bretagne-Atlantique (French Sea Innovation Cluster), which targets the end users linked to the subject. The survey was distributed by email.

For the Cypriot survey, the survey was disseminated to a total of 20 contacts across the country. The stakeholders have been identified from the list of contacts by various departments, targeting academia, private, as well as public sector and have been contacted via mass emails, as well as individual emails for reminders etc. The list of contacts has been derived from previous projects related to the marine sector.

The dissemination to non-European stakeholders was implemented by contacting AIR Centre's network focal points and partners linked to actions 2021-2-31[3] (South America) and 2021-2-39[4] (Africa) that distributed the survey through their communication channels. Brazil, Panama, Guatemala and Colombia were selected as countries in South America, while Cabo Verde and Nigeria were targeted in Africa. The total number of partner's focal points contacted by email was 18 for South American countries and 11 for African countries.

[3] https://www.copernicus-user-uptake.eu/user-uptake/details/user-uptake-in-central-and-south-america-528

[4] https://www.copernicus-user-uptake.eu/user-uptake/details/copernicus-user-uptake-in-africa-492

4. Results

4.1. GENERAL OVERVIEW

The survey received a total of 172 responses. The highest number of responses came from Spain (58), followed by Portugal (39), Brazil (25), France (15), Panama (13), Cyprus (11), Cabo Verde (10) and Nigeria (1). For the following analysis the responses from non-European countries were grouped into two regions: Africa and South America, with a total number of replies of 11 and 28, respectively. The profile of the stakeholders that responded to the survey is shown in Figure 4.1.1.

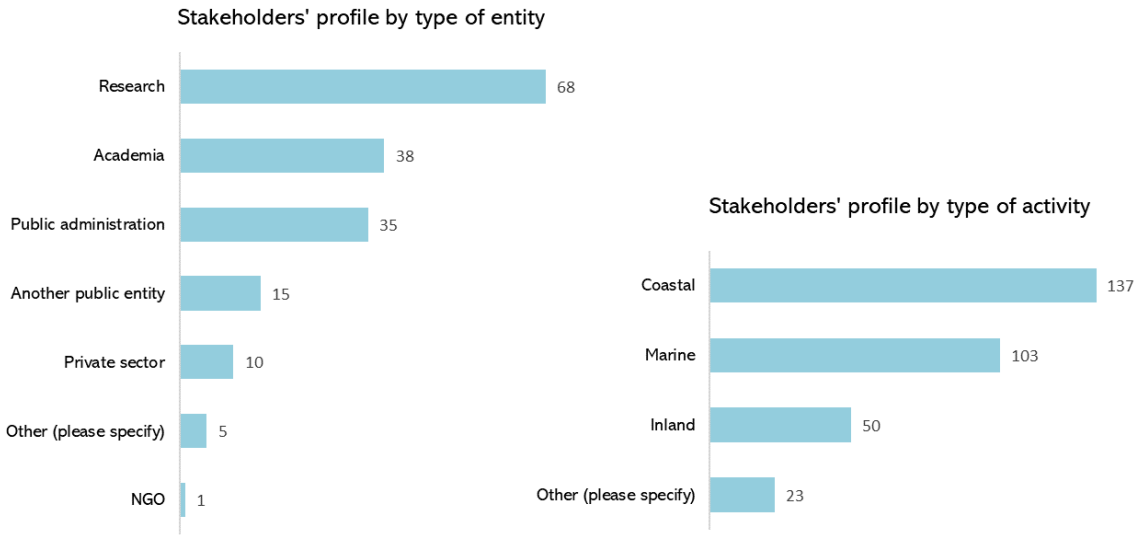

Figure 4.1.1 Stakeholder's profile by type of entity and by area of activity.

Regarding **type of entity**, they are mostly from research institutions (68), followed by academia (38) and public administration (35). There were also contributions from other public entities (e.g., federation of fishermen's cooperatives, marine conservation societies and foundations, public administrative establishments, national committee shell farming, port authorities) (15), private sector (10), and non-governmental organisations (1), with a few respondents falling into the "other" category (e.g., higher education, private non-profit association) (5). Regarding their **type of activity** (coastal, marine, inland), most of the respondents are interested in coastal (137) and marine (103) activities. Only 50 are interested in inland activities. A smaller number is involved in other types of activities (23) (e.g., land and environmental management, agriculture). This indicates a participation that is primarily research-oriented and focused on marine and coastal realms. It should be

mentioned that the majority of stakeholders interested in the marine activities also expressed interest in coastal activities.

The overall **relation of stakeholders to the various marine-related sectors** was evaluated with a multiple answer question, so that respondents could select more than one sector of their interests or involvement (Figure 4.1.2). The analysis revealed that "Others" received the highest number of responses (91). Of these, 72 selected the predefined category "scientific research", confirming the stakeholder profile analysis.

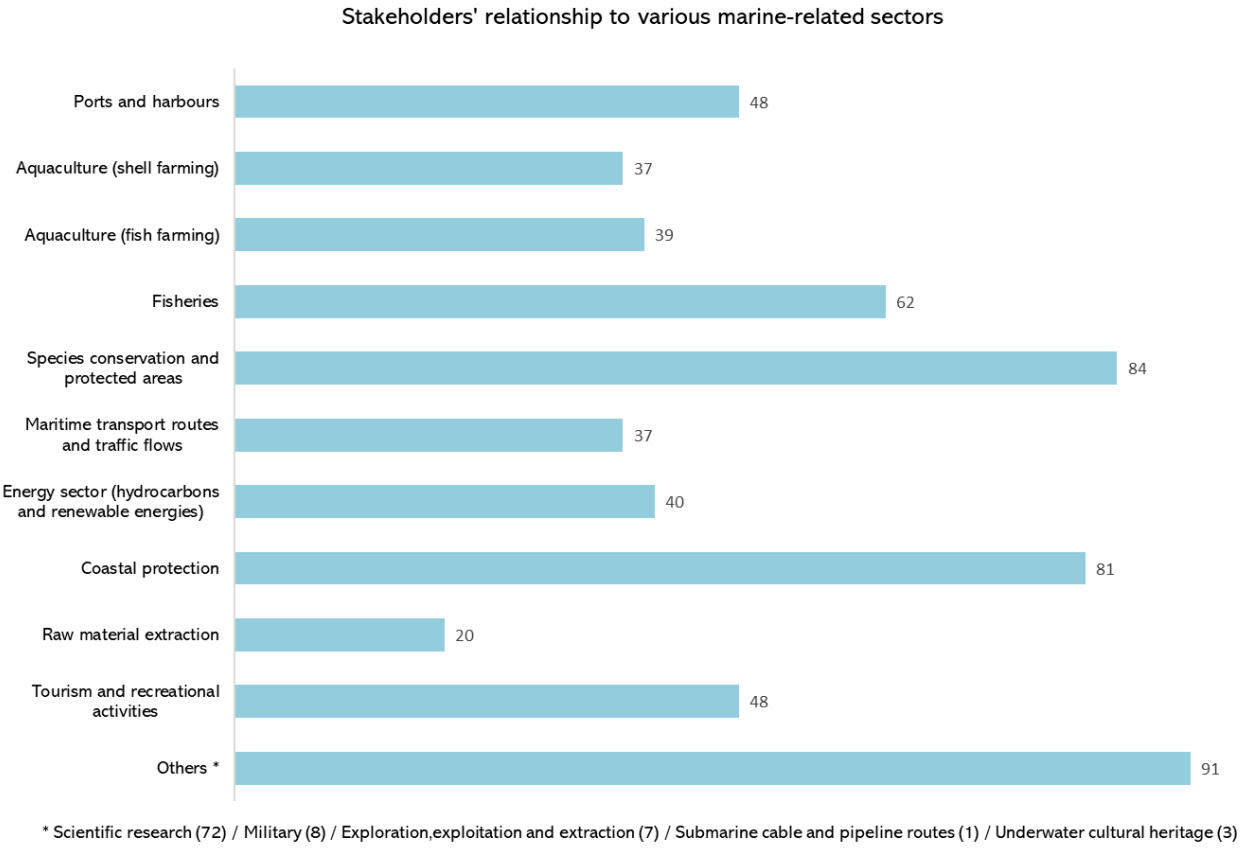

Figure 4.1.2 Stakeholder's relationship to various marine-related sectors.

The second highest number of responses was for "species conservation and protected areas" (84), followed by "coastal protection" and "fisheries", with 81 and 62 responses, respectively. "Tourism and recreational activities" and "Ports and harbours" had both 48 responses, "Energy sector" 40, "fish farming Aquaculture" 39, and both "shell farming Aquaculture" and "Marine transport routes and traffic flow" were selected by 37 respondents. "Raw material extraction" had the lowest response count (20). Same applies to the Other sub-categories such as "Military", "Exploration exploitation and extraction", "Submarine cable and pipeline routes" and "Underwater cultural heritage".

Overall, the analysis demonstrates the prominence of stakeholder interest in species conservation, coastal protection, and fisheries from the point of view of scientific research activities.

4.2. MARINE SECTORS

In this section, only the respondents that expressed interest in the sectors Ports and harbours, Aquaculture (shell and fish farming) and Fisheries were considered.

4.2.1 Ports and harbours

The profile of the stakeholders that showed interest in the Ports and harbours sector is shown in Figure 4.2.1. Again, entities related to research (17) and public administration (16) were the most represented. Other entities such as academia, another public entity, private sector, NGO, and other categories contributed with fewer responses.

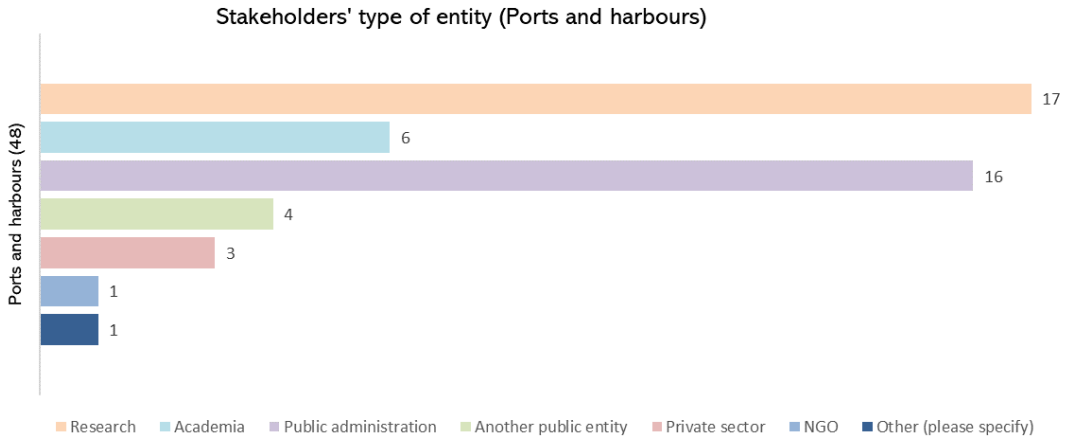

Figure 4.2.1 Stakeholders' type of entity for the Ports and harbours sector.

The interest in the different services of the sector Ports and Harbours is shown in Figure 4.2.2. The analysis is performed overall, including the replies from all countries (upper plot), and per country/region.

Overall, all countries included, "pollution and environmental monitoring" emerged as the most interesting service for the stakeholder, followed closely by the "maritime climate" service. Services related to "ship detection", "effects of climate change" and "navigation and dredging operations" received a moderate level of interest. "Infrastructure monitoring" received the lowest rating.

The breakdown of responses by country/region indicates a general preference for "maritime climate" services in Portugal, Africa, and South America respondents. Otherwise, Spanish stakeholders rated "pollution and

environmental monitoring" as the most interesting service, while French selected "navigation and dredging operations" the most.

A shared lower interest emerged for the "infrastructure monitoring" services across most countries/regions excluding only South America where their least interesting service appeared to be "navigation and dredging operations".

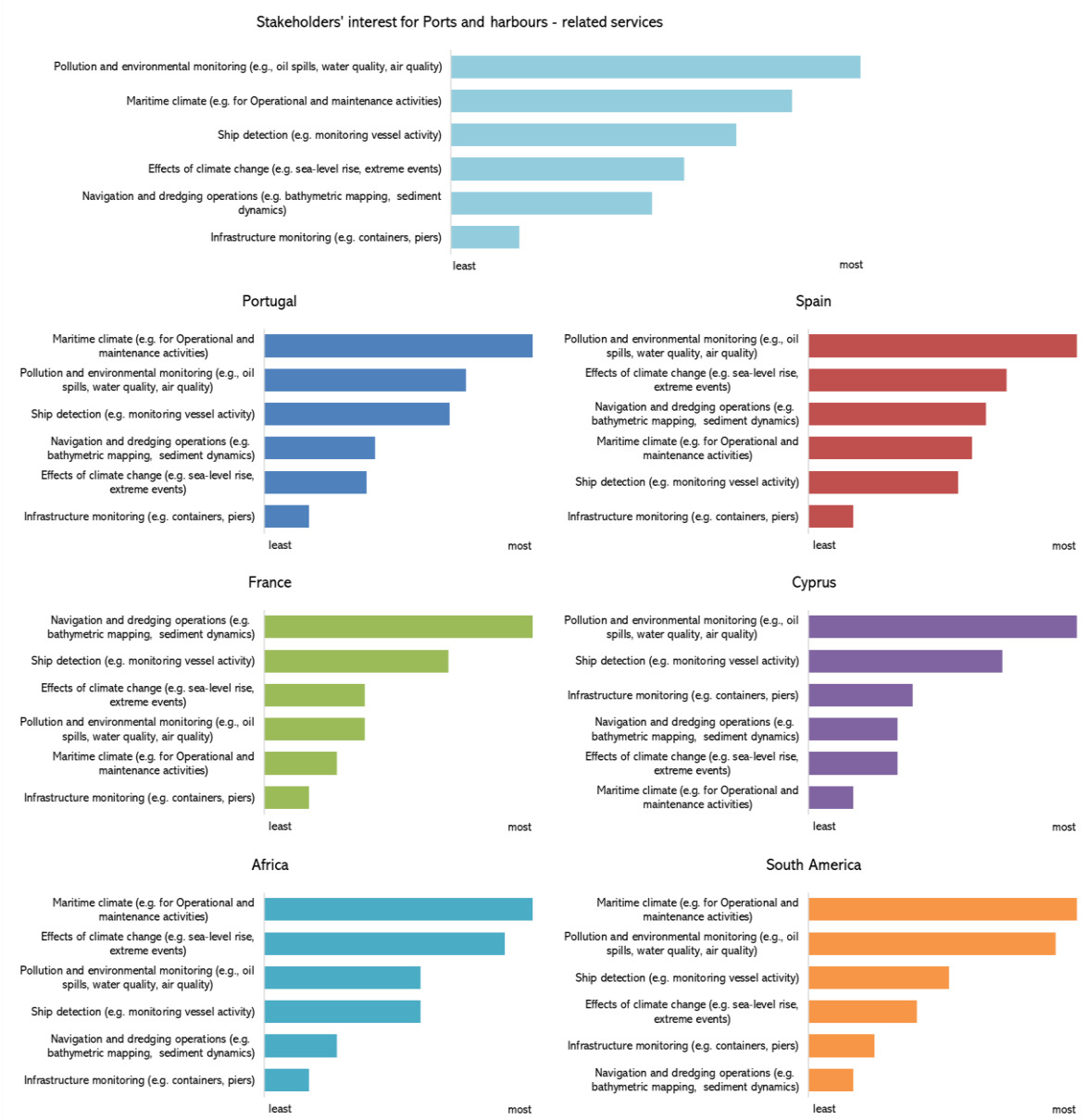

Figure 4.2.2 Stakeholders' interest for Ports and harbours – related services. Overall view and breakdown by country or region.

4.2.2 Aquaculture

The analysis of the responses for the Aquaculture sector while accounting for the type of entity (Figure 4.2.3) showed that research-related entities (14) and public administration (13) provided the highest number of responses, showing a significant level of engagement. This was followed by other entities such as academia (9) and other public entities (8). Private sector and other categories contributed with fewer responses or zero responses (NGO), indicating a comparatively lower level of involvement in this activity for this specific sector.

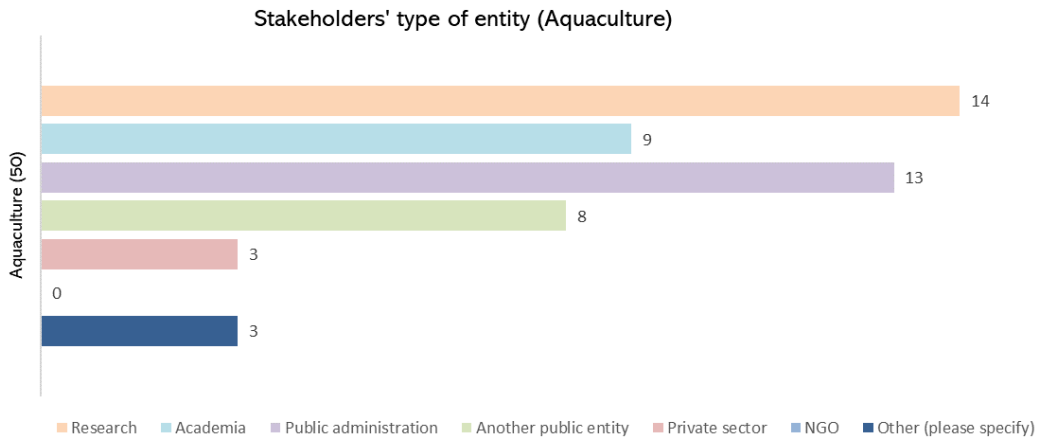

Figure 4.2.3 Stakeholders' type of entity for the Aquaculture sector.

The analysis of the stakeholders' interests in Aquaculture services was performed considering the two distinct sub-sectors: shell farming and fish farming.

Shell farming aquaculture

For shell farming aquaculture, among the rated services (Figure 4.2.4), "oceanographic data", "pollution and environmental monitoring" and "marine water quality" emerged equally as the most interesting services for the stakeholders. Followed, with moderate interest, by the service related to "selection of suitable site location and species" indicating its notable importance within the sector. Services related to the "effects of climate change", "infrastructure monitoring" and "ship detection" showed a lower level of interest.

The breakdown overview of responses by country/region is consistent with the general overview, demonstrating a clear preference among stakeholders across countries or regions for services like "pollution and water quality", "marine water climate", and "oceanographic data". Regarding the service of "selection of suitable site location and species" a discrepancy is shown between replies from France and Spain, with the latter rating this service as the most interesting while French stakeholders as the least interesting one.

Figure 4.2.4 Stakeholders' interest for Shell Farming Aquaculture – related services. Overall view and breakdown by country or region.

Fish farming aquaculture

For fish farming aquaculture, among the rated services (Figure 4.2.5), "oceanographic data" appeared as the most interesting service for the stakeholders, in agreement with shell-farming stakeholders. In contrary fashion, "ship detection" and "effects of climate change" were the second and third most interesting services, respectively. Services related to "infrastructures monitoring" showed the lowest level of interest.

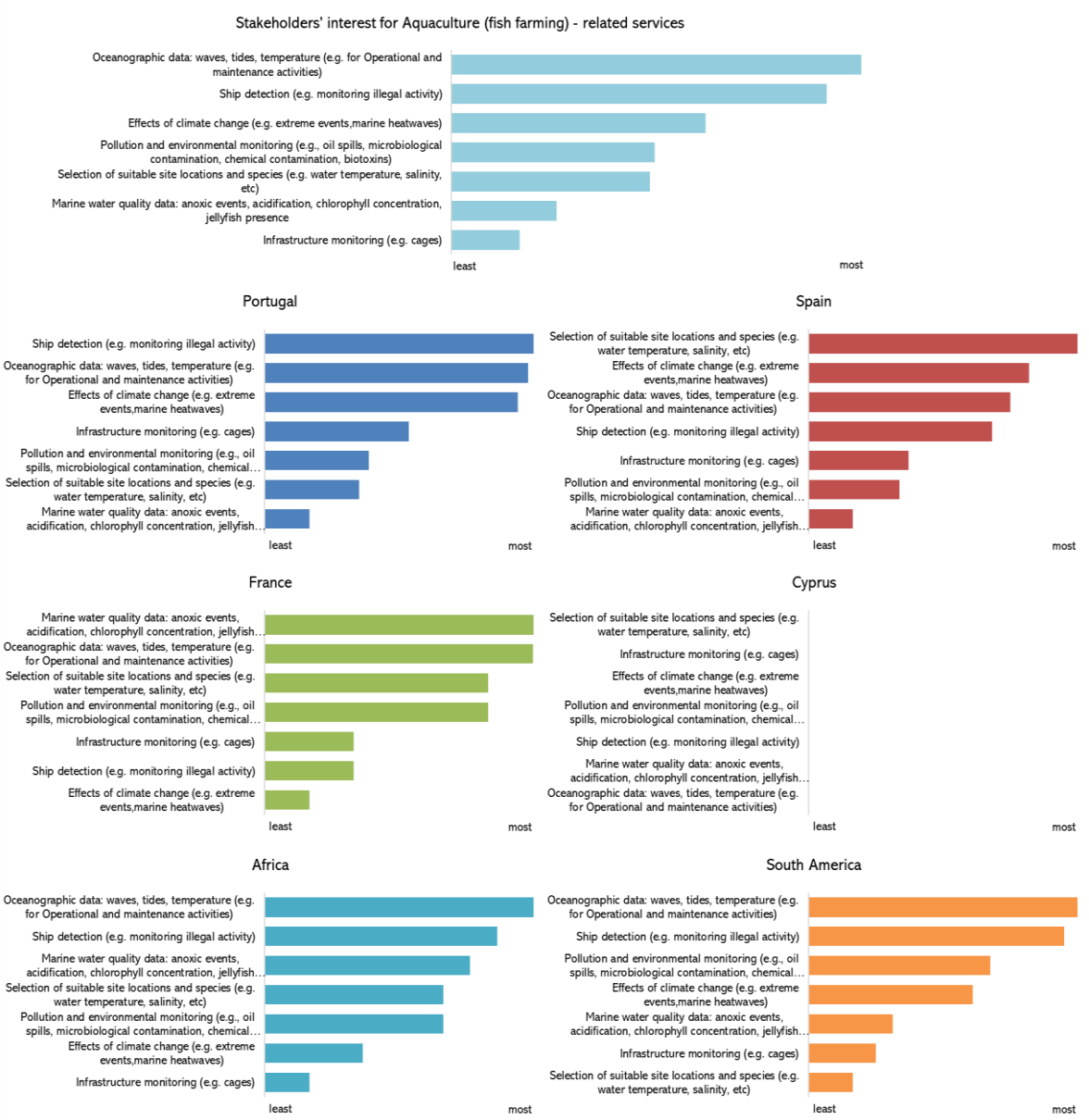

Figure 4.2.5 Stakeholders' interest for Fish Farming Aquaculture – related services. Overall view and breakdown by country or region.

The breakdown overview of responses by country/region shows a slightly different pattern across countries and regions. Spanish stakeholders rated the "selection of suitable site location and species" as the most interesting service, while African stakeholders rated it as the least. A discrepancy is also observed for the "marine water quality service", with Portuguese and Spanish stakeholders identifying it as least interesting, whereas French respondents rated it as most interesting.

4.2.3 Fisheries

The analysis of the responses for the Fisheries sector regarding the type of entity (Figure 4.2.6) showed clearly again that research-related entities (25) provided the highest number of responses, followed almost equally by other entities such as academia (12) and public administration (13), and another public entity (8). Private sector and other categories contributed with fewer responses indicating a comparatively lower level of involvement in this activity for this specific sector.

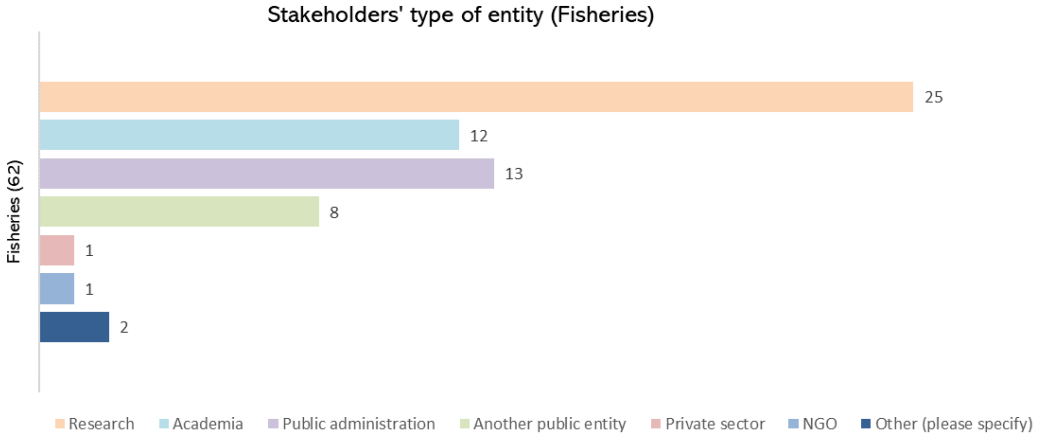

Figure 4.2.6 Stakeholders' type of entity for the Fisheries sector

Among the rated services (Figure 4.2.7), "fishing area characterization" and "maritime climate" emerged as the most interesting services for the stakeholders related to fisheries. Followed closely by the "pollution and environmental monitoring" service indicating its notable importance within the sector. Services related to "ship detection", "effects of climate change" and "map of sea use" received a moderate level of interest. In contrast, "fisheries certification" received the lowest rating. This suggests that stakeholders found it the least interesting service.

The breakdown overview of responses by country/region indicates a consistent pattern with a general preference for the "fishing area characterization" service. Differently, regarding "maritime climate", the Spanish and French stakeholders rated this service with less interest than other countries/regions. Also, the "map of sea use" service received a higher rate by Spain with respect to other countries or regions. In line with the general overview, a shared lower interest emerged for the "fisheries certification" service across most countries/regions.

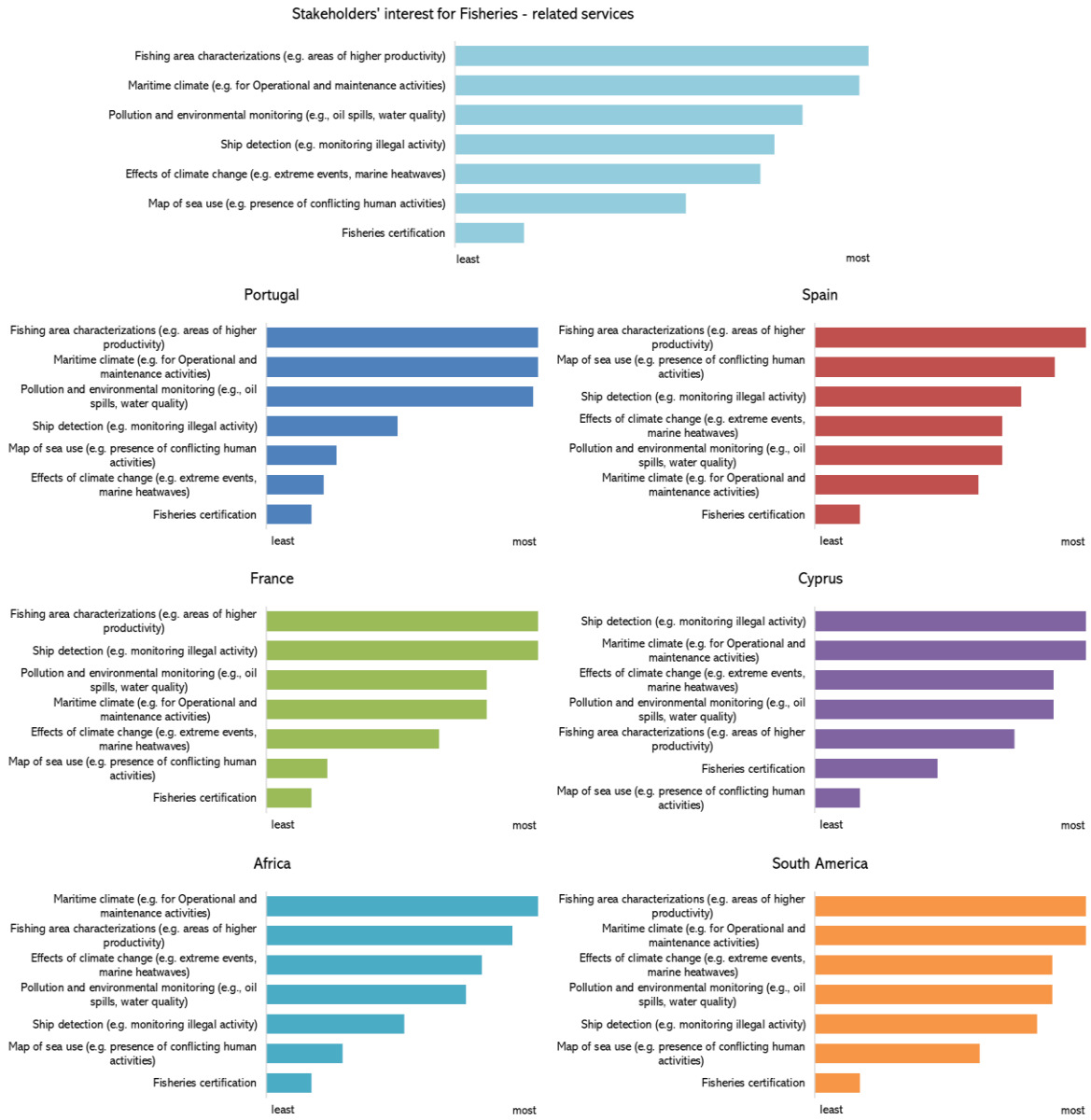

Figure 4.2.7 Stakeholders' interest for Fisheries – related services. Overall view and breakdown by country or region.

4.3. DATA NEEDS & COPERNICUS USAGE

The survey allows us to understand the general issues and data needs of stakeholders, in terms of Copernicus for their current activities. In this section, once again, the focus is only on the responses from stakeholders that selected ports and harbours, aquaculture or fisheries as their sector of interest. It is noted that this analysis is not specific for each of these sectors, as one stakeholder could be interested in up to 10 sectors listed in Figure 4.1.2 (see also Annex II

for the analysis of replies by sector). To have this analysis per sector, it would have been required that these questions were done repeatedly for each of the sectors of interest (up to 10), which was decided not to be done, to avoid repetitions and stakeholder fatigue. Nevertheless, the present analysis still provides a broad insight into the challenges and requirements for users interested in these 3 sectors as a whole. Whenever possible, the results are coloured-specific per sector to illustrate differences.

4.3.1 Overview of general data use and needs among stakeholders

Regarding general data usage, when asked about the most common problems encountered while working with data (Figure 4.3.1), most stakeholders mentioned the challenges associated with the incomplete temporal distribution of the datasets (84), the inaccessibility or unavailability of data (83), the incomplete spatial distribution of datasets (74) and the lack of tools to manipulate and visualise the data (66). These answers highlight the need for improved data accessibility, availability, and coverage. Less problematic seems to be the reliability, type of source and data format.

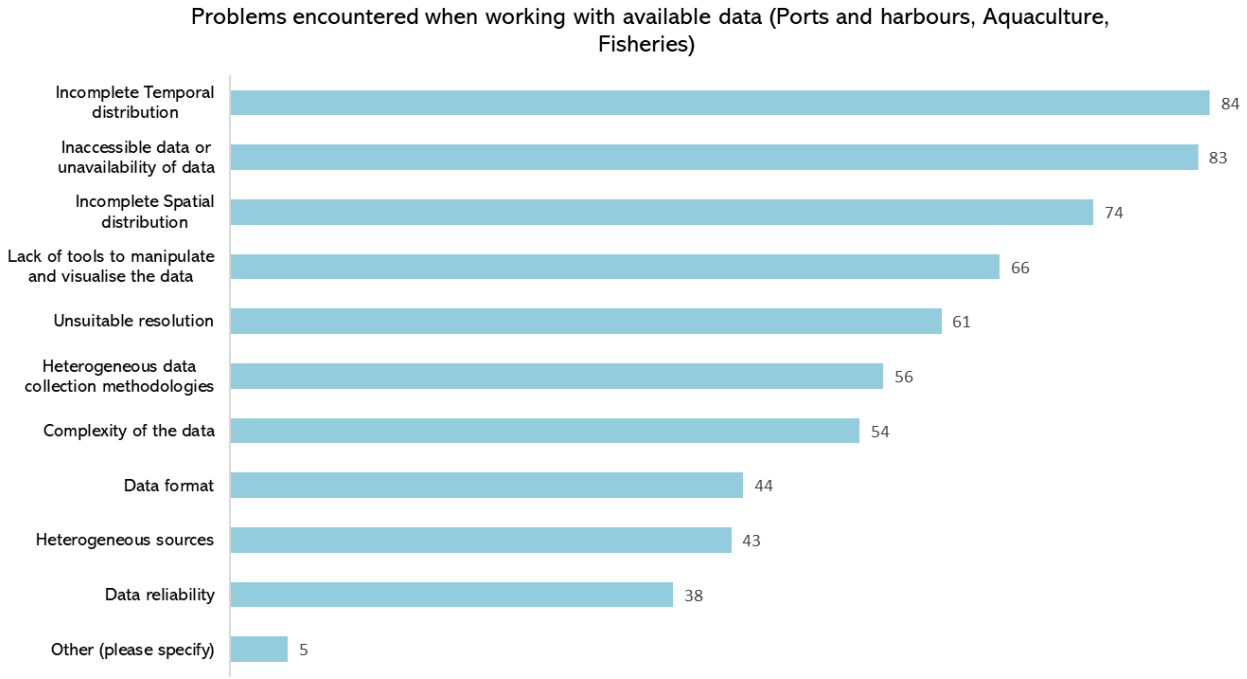

Figure 4.3.1 Stakeholders' problems encountered when working with available data (Ports and harbours, Aquaculture, Fisheries).

In terms of the temporal extent of data (Figure 4.3.2), stakeholders expressed a higher need for long-term historical data series (120) and real-time or near real-time data (93). This indicates a demand for both historical context and up-to-date information.

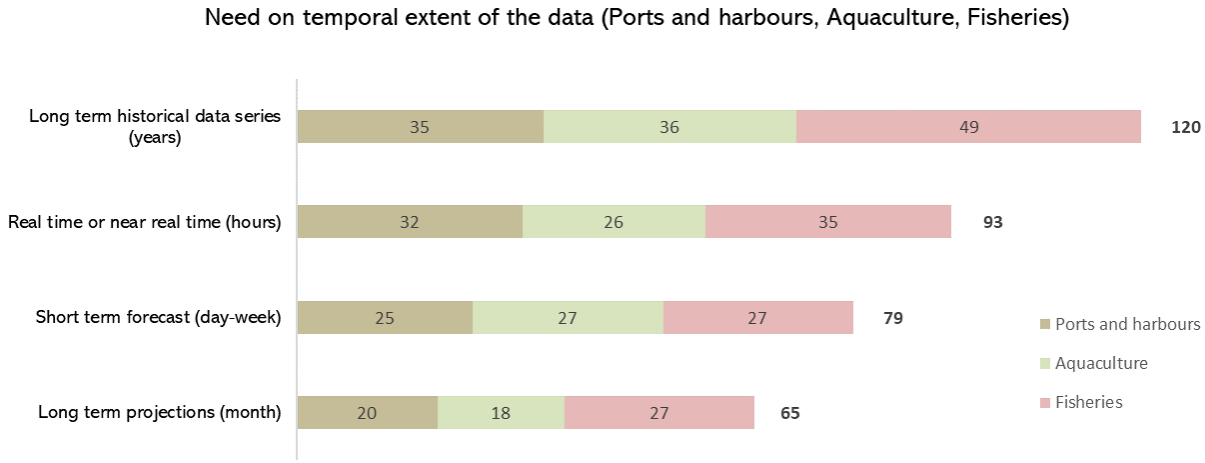

Figure 4.3.2 Stakeholders' needs considering the temporal extent of the data.

Concerning the spatial resolution of data (Figure 4.3.3), stakeholders generally showed a preference for high (1-5 m) (71) and medium (5-30 m) (74) spatial resolutions, with a slight difference for the aquaculture sector, least interested in medium resolution data. Overall, the analysis suggests a need for medium-to-high spatial resolution data.

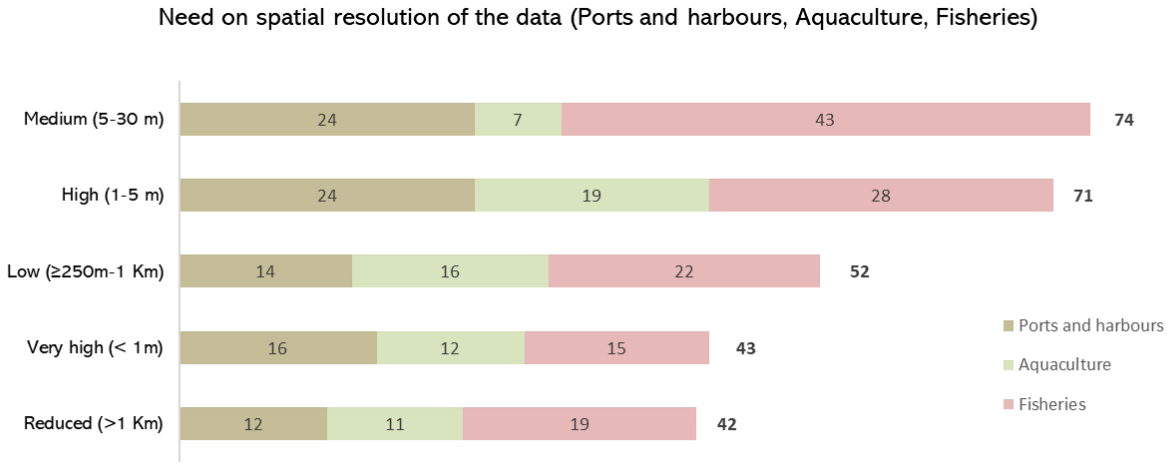

Figure 4.3.3 Stakeholders' needs considering the spatial resolution of the data.

Generally, the analysis reveals a common theme of **data availability, accessibility, and completeness** as significant challenges faced by stakeholders. Furthermore, there is a clear demand for both historical data series and real-time/near real-time data, indicating the need for comprehensive temporal coverage. Additionally, stakeholder preference for high and medium spatial resolutions highlights the importance of detailed and accurate spatial information for various applications. The results suggest an overall need for comprehensive and high-quality data that is readily available and covers both temporal and spatial dimensions.

4.3.2 Copernicus data use and needs among stakeholders

The following analysis focuses on the part of the survey aimed to understand the awareness, data usage, needs and satisfaction with Copernicus products for these stakeholders.

The majority were aware of the Copernicus program (Figure 4.3.4), with approximately 80% of stakeholders having heard of the program.

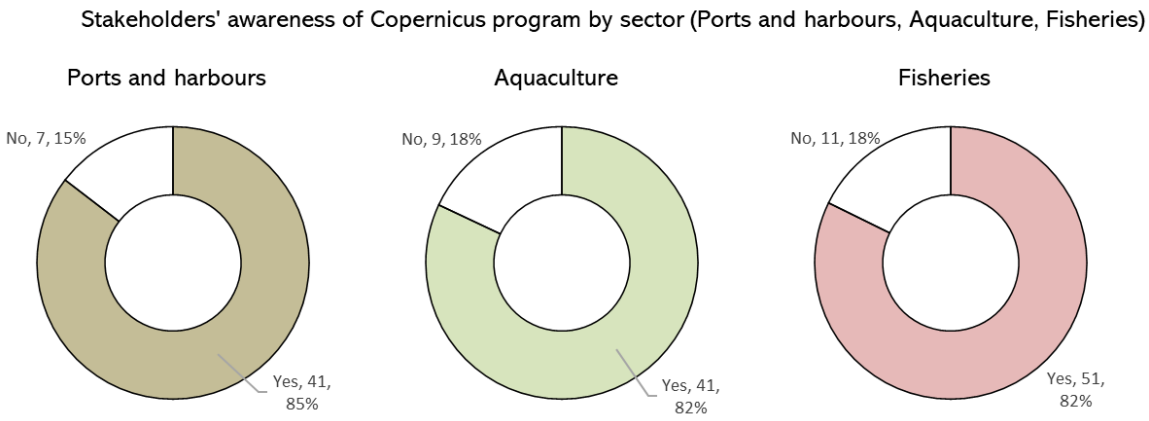

Figure 4.3.4 Stakeholders' awareness of the Copernicus program across the 3 sectors.

For the stakeholders that were aware of the program, it was asked about their familiarity with the difference between Copernicus Satellite Data (e.g., Sentinel missions' data) and Copernicus Service Products (e.g., CMEMS) (Figure 4.3.5; definitions provided in survey introduction, see annex I). Familiarity was highest in ports and harbours (63%) sector followed by the fisheries sector (49 %) and aquaculture (44%). Notably, a significant number of stakeholders were not familiar with this distinction in each sector.

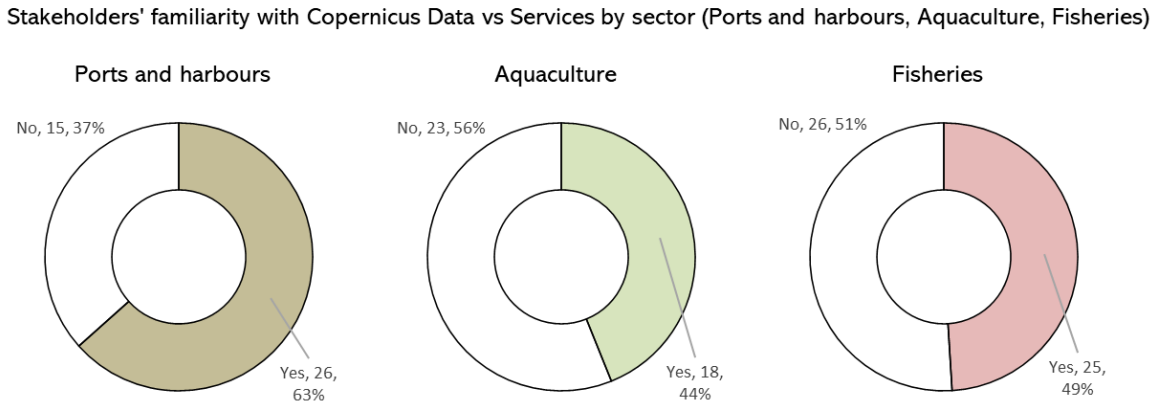

Figure 4.3.5 Stakeholders' familiarity with the distinction between Copernicus Data and Services across the 3 sectors.

For the stakeholders that mentioned being aware of the program it was further questioned their usage of Copernicus Data (Figure 4.3.6). The results indicate similar utilisation rates among sectors. Roughly, half of stakeholders make use of Copernicus Data.

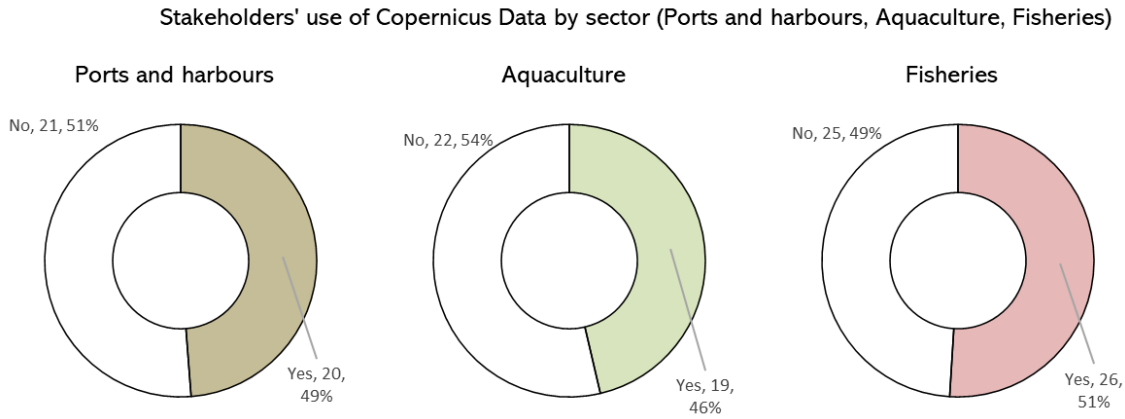

Figure 4.3.6 Figure 5.3.6 Stakeholders' use of Copernicus Data across the 3 sectors.

For the stakeholders that declared not using Copernicus (Figure 4.3.7), the majority of respondents (77%) stated that the main reason for it was lack of **knowledge or skills to use the data**, while 13% declared not having enough human resources or time to do it.

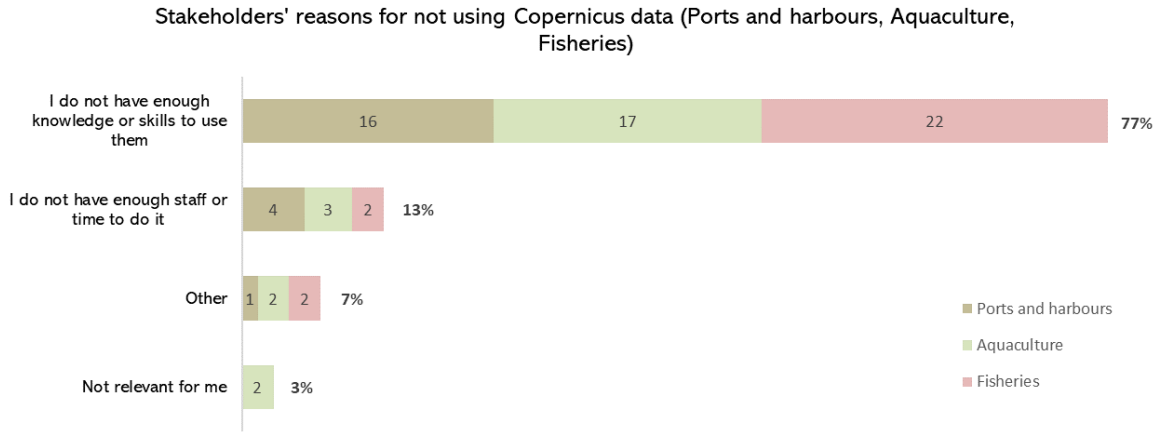

Figure 4.3.7 Stakeholders' reasons for not using Copernicus Data.

For the stakeholders that declared using Copernicus data, the periodicity of usage, type of data used, and user level proficiency were further inquired. The analysis indicates a frequent and consistent utilisation of Copernicus data among stakeholders (Figure 4.3.8). The majority of stakeholders (36%) reported using Copernicus data on a monthly or weekly basis, and 28% use it only on an annual basis.

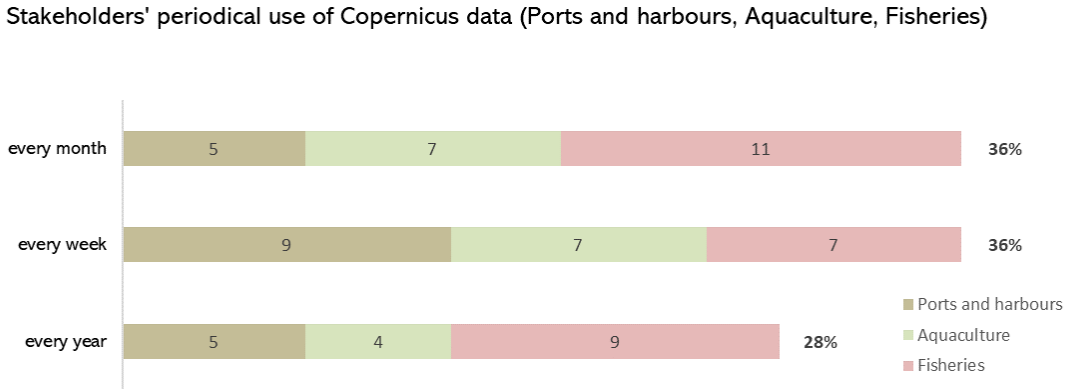

Figure 4.3.8 Stakeholders' periodical use of Copernicus Data.

Satellite-derived products support most stakeholders activities (Figure 4.3.9) with 73% of stakeholders relying on them. Model-derived products are used by 16% of stakeholders, and in-situ data by 11%.

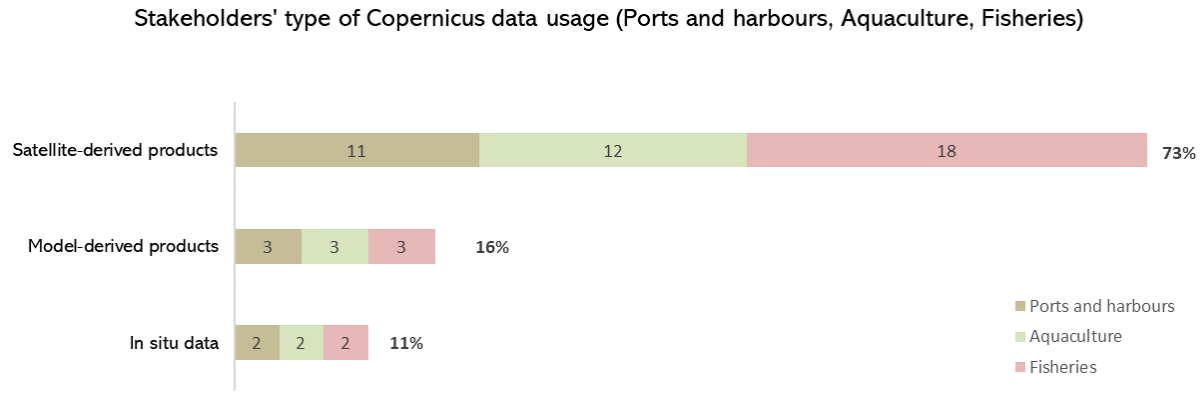

Figure 4.3.9 Stakeholders' type of Copernicus Data usage.

In terms of user proficiency, 41% of stakeholders identified themselves as intermediate users of Copernicus data (Figure 4.3.10), while 34% considered themselves advanced users, and 25% described their proficiency level as basic. This suggests a diverse range of proficiency levels among stakeholders, with a substantial proportion having intermediate and advanced skills.

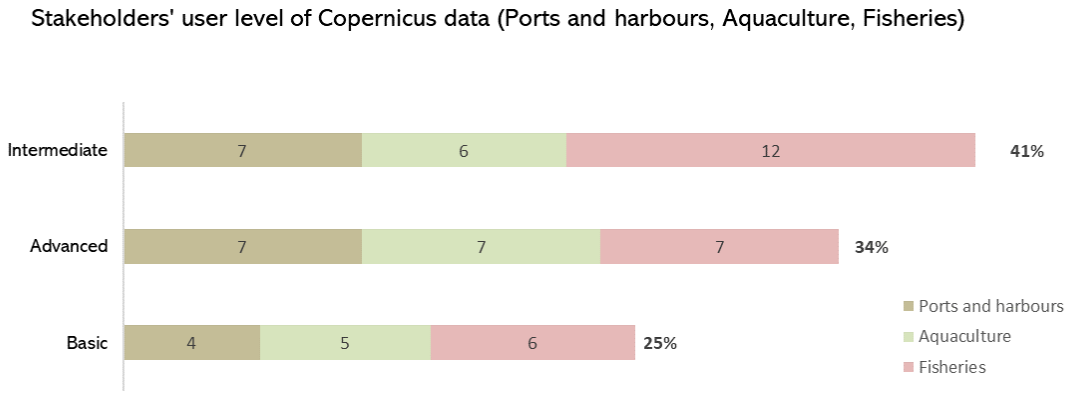

Figure 4.3.10 Stakeholders' user level of Copernicus Data.

Analysing the stakeholders reported levels of satisfaction (Figure 4.3.11) with the Copernicus program and its products across all sectors, reveals that a significant proportion expressed being extremely satisfied (44%) with the Copernicus program and its services. Additionally, 33% of stakeholders reported being very satisfied, and a notable portion of stakeholders (21%) expressed a neutral position. Most importantly, no stakeholders have indicated being unsatisfied with the Copernicus program products and services.

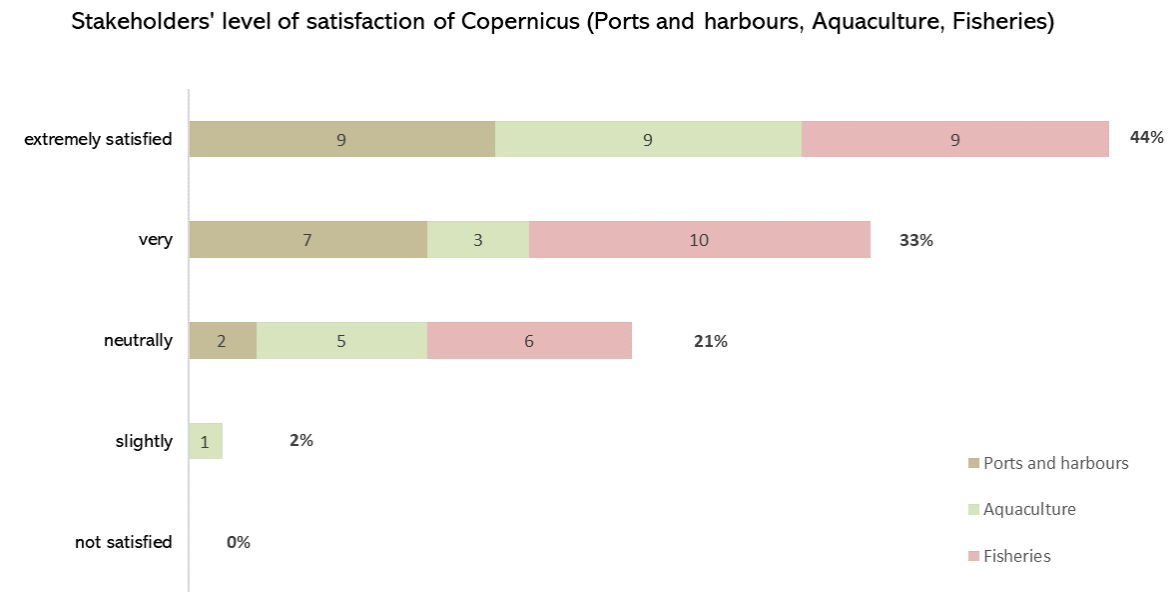

Figure 4.3.11 Stakeholder's level of satisfaction of Copernicus.

4.3.3 Data analysis tools

Analysing the stakeholders most-used data tools for Copernicus data analysis (Figure 4.3.12) reveals that Mapping software are the most used for visualising and analysing Copernicus data in a spatial context. This was followed by programming languages, highlighting their significance for advanced data analysis and customization of Copernicus data workflows. Image processing software and visualisation software both received slightly lower responses.

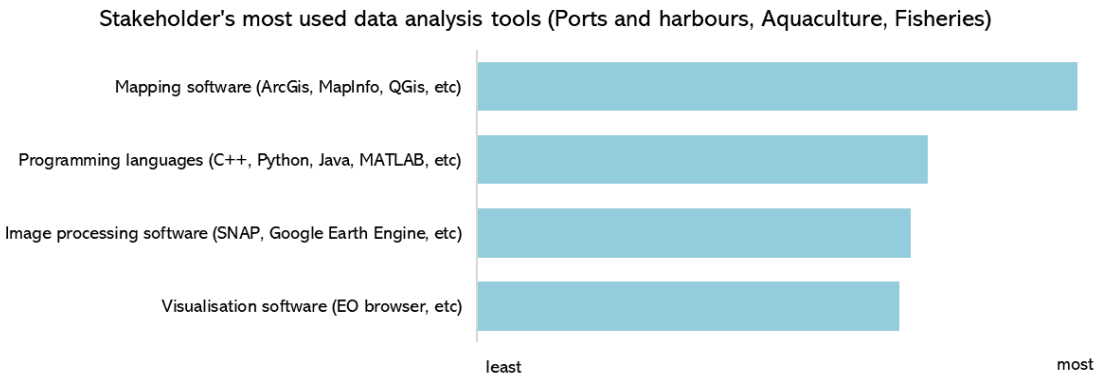

Figure 4.3.12 Stakeholders' most used data analysis tools.

4.3.3 Open-ended questions

Three open-ended questions were asked at the end of the survey to get further information on: how users think that Copernicus data can be improved (Q30.vi), stakeholders' needs besides Copernicus data (Q32) and other relevant space solutions for the maritime domain (Q33). It is provided below a summary of the answers to these questions.

Regarding the responses (57 users) to the first question (Q30), How Copernicus data can be improved, stakeholders suggested the following:

- more than 58% stated a need of improved spatial and temporal resolution,
- around 33% referred to problems with data access and downloading,
- they mention the need for easier data access to tailored products and request the development of a more user-friendly interface which facilitates the data download strategy and makes it easier to extract, especially, large amounts of data. In this regard, they propose the availability of user manuals for user consultation, including tutorials for better data handling and download, tools on the Copernicus platform and data catalogue, and making images available in other formats to facilitate processing e.g., TIFF and even in ASCII type,
- some users (11%) referred to the need of having finer resolution models available for small areas, like some islands or coastal areas,
- other users (9%) referred to historic data availability, stating the need for longer historical time series.

Inside Q30, some users also mentioned the need for new or improved Copernicus products:

- datasets related with:
    - impacts of climate change,
    - detection of large cetaceans,
    - anthropogenic impacts, such as pipelines, legal and illegal outfalls, FMS maritime traffic, etc.,
- improved products of physic-chemical variables (e.g., nutrients, water quality),
- improved satellite products in coastal areas.

Regarding the responses (60 users) to the second question (Q32), needs besides Copernicus data, stakeholders expressed the need for:

- in-situ data, including meteorological, oceanographic, and ecological parameters, to validate and complement the Copernicus data,
- data on river flow, water quality, biodiversity distribution, fisheries information, bathymetry, and species distribution,

- monitoring and mapping tools and services related to monitoring coastal evolution, beach sediments, marine habitats, and vulnerable ecosystems,
- real-time data to monitor activities such as maritime traffic, compliance with regulations, and changes in marine environments,
- open-access databases, integration of multidisciplinary data, improved data management tools, and easy access to national monitoring campaigns.

Regarding the responses (62 users) to the third question (Q33), other relevant space solutions for the maritime domain, stakeholders noted the following solutions:

- better spatial and temporal resolutions in data and products to capture fine-scale coastal processes and meet specific application requirements,
- easier access to data, improved downloading processes, and user-friendly interfaces to facilitate the utilisation of space solutions effectively,
- specific types of data, such as in-situ wind data, historical data, 3D oceanographic models, and physicochemical variables for monitoring water quality and detecting climate change impacts,
- new products, including higher-resolution satellite imagery, hyper-spectral data, and datasets related to anthropogenic impacts and maritime traffic,
- integrating Copernicus data with other platforms, such as EmodNet, and the need for compatibility with various software tools, including SNAP and other existing platforms.

Full answers to the above questions (Q30.vi, Q32 & Q33) are reported in the Annex III.

5. Discussion

The total of 172 collected answers is a satisfactory number in absolute terms. The geographical distribution of answers suggests under-representation of France (15), Cyprus (11) and African countries (11), with respect to Spain (58), Portugal (39) and South American countries (38). The survey garnered a total of 123 responses from EU countries and 49 from non-EU countries, allowing it to effectively capture the needs and requirements of stakeholders from both European maritime sectors and beyond. Thus, the survey successfully achieved its objective of providing insights into the overall requirements of maritime stakeholders from both within and outside the European region.

In relative terms, the survey was disseminated to a total of approximately 600 contacts across all countries and regions, highlighting a total response rate of around 30 %.

A target of 200 replies across all four participant countries and a number of 50 replies by sector, were the goal and expected output for the survey in the action proposal. The number of replies by sector of interest were 48, 50 and 62 respectively, and not exclusively, for Ports and harbours, Aquaculture and Fisheries.

When looking at the survey considering all the sectors included, the analysis reveals a pattern where there is a majority of respondents that come from research-related entities, suggesting a strong engagement by academic and scientific stakeholders (Figure 4.1.1). Additionally, the high number of responses related to coastal and marine activities suggests a specific focus on these areas. Overall, the analysis demonstrates the prominence of the stakeholders' interest in "species conservation", "fisheries", "coastal protection", and "tourism" (Figure 4.1.2). These sectors likely hold significant importance and influence in the marine-related discussions and initiatives among the surveyed participants. However, the "Other" category received the highest number of responses (91), indicating that there are diverse and varied relationships between stakeholders and marine-related sectors beyond the predefined categories. This suggests a wide range of interests and affiliations not captured by the specified sectors, especially regarding research-related activities.

When looking at the survey considering only 3 specific sectors of interest (Ports and harbours, Aquaculture and Fisheries) the distribution of responses across the 3 sectors was balanced, promoting confidence for the progress of the next action goals. The distribution by type of entity (Figure 4.2.1, Figure 4.2.3, Figure 4.2.6) shows a very low contribution and engagement by private entities (6 for all 3 sectors) since the majority of respondents come from research-related entities, academia and public administration, reflecting the difficulty in engaging the private sector in surveys and calling for innovative ways to convince these stakeholders to participate.

Upon analysing the services of higher interest across the three sectors (Figure 4.2.2, Figure 4.2.4, Figure 4.2.5, Figure 4.2.7), it becomes evident that "pollution and environmental monitoring" consistently stood out as highly rated and crucial services. "Oceanographic data" also received significant interest across the Aquaculture and Fisheries sectors. Furthermore, there were differences in preferences between the sectors. For example, "maritime climate" and "infrastructure monitoring" were of particular interest in the Ports and Harbours sector, while "ship detection" and "effects of climate change" were prioritised in the Aquaculture and Fisheries sectors. Discrepancies in preferences were observed across countries, indicating regional variations in priorities and needs. For instance, while "selection of suitable site location and species" was identified as a priority for some Spanish stakeholders dealing with shellfish farming, it has been rated the least important for French stakeholders. These

differences may arise from different national marine spatial planning implementation strategies, national laws, geographic limitations or diverse a priori knowledge from stakeholders. These differences will be explored during the regional and thematic workshops to get further insights. Overall, understanding and addressing environmental concerns, such as "pollution monitoring" and "oceanographic data", were common focal points across the sectors.

The responses to questions regarding issues of working and availability of data (Figure 4.3.1) reveal a general balance among the different reasons provided. This indicates that a simple solution will not be enough, and multiple actions are necessary to increase user satisfaction. The responses related to the characteristics of satellite data, such as spatial resolution (Figure 4.3.3), highlighted the need for high spatial resolution (1-5m) and medium resolution (5-30m) by a significant number of users. Notably, the very high resolutions (< 1m) were amongst the least selected. In any case, this poses a challenge for the Copernicus program, as missions focused on marine applications, such as Sentinel-3 and Sentinel-6, primarily provide low resolution data. It remains unclear from the survey structure and responses if the almost-daily revisit of these missions adequately meets user needs (Figure 5.3.2). It is possible that the current revisit rate, affected by cloud coverage, also results in unsatisfactory temporal resolution.

Concerning questions on the usage of Copernicus an equal distribution of responses was observed across the 3 sectors, with the following outcomes:

- There is a high level of awareness regarding the Copernicus program, however only half of stakeholders use the data. The other half (non-users of Copernicus data) lacks knowledge or skills to manipulate the data. This highlights that there is still a great potential for further uptake and utilisation of Copernicus data.
- The kind of products used (Figure 4.3.9) is well balanced between satellite data and models, with in situ data having a minor role. Considering that satellite data are also key inputs for models, it is clear the importance of satellite data.
- A regular and frequent usage of Copernicus data (Figure 4.3.2) is reported by the stakeholders that exhibit intermediate to advanced skills (Figure 4.3.10). However, still a quarter of the users stated basic skills, showing room for improvements.
- There is a general positive level of satisfaction regarding Copernicus data, with no reported dissatisfaction. This is clearly a success for the program, but there is also, clearly, space for improvement.

The answers to the open-ended questions further underline the importance and need for improvement and lay out some priorities such as: better spatial and temporal resolutions, easier data processing and analysis, real-time data, longer historical time series data, accessibility, and finer resolution models targeted to small areas like islands or coastal regions. Specific data requirements in the maritime domain also include in-situ data to support various applications such as environmental monitoring, fisheries management, and coastal mapping. Stakeholders seek space solutions that address their unique needs, such as monitoring coastal areas, assessing environmental impacts, and detecting climate change effects. The desire for user-friendly interfaces and seamless integration with existing tools like EMODNET also underscores the relevance of improvements for smooth and efficient workflow. Moreover, users proposed several new products they would like to see in the Copernicus program. These include improved products of physicochemical variables related to water quality and also suggest datasets related to the impacts of climate change, detection of large cetaceans and anthropogenic impacts, such as pipelines and maritime traffic. Furthermore, there is a request for satellite products specifically focused on coastal areas.

6. Conclusions

The survey has been completed in a satisfactory way, providing a solid ground for the continuation of the action. The total number of replies per section fits in the indicator targeted in the action proposal. While the relative number of replies was a little low compared to the number of contacts addressed, it should be stated that in most countries the desired target replies have been achieved.

A specific effort should be made in this action to reach out to users (actual or potential) in the private sector. Their reduced contribution to the survey not only precludes the inclusion of their needs in this assessment but might indicate a lack of knowledge or a lack of confidence in Copernicus, and both cases should be addressed. It is however recognised that the mailing lists gathered for the survey dissemination were short on this type of stakeholders and an effort to improve the engagement with the private sector will be done during the workshops organisation to guarantee that their views and needs are duly taken into account.

Approximately 50% of the users work with Copernicus, and these users are mostly satisfied with the programme. However, increased spatial resolution (and maybe temporal resolution / revisit) is still a popular demand and should be considered, amongst other issues, in the evolution of the system.

Finally, it seems that dissemination and training actions amongst potential users should still, 25 years later, be a priority for the Copernicus programme.

All these results will be considered in future development of this action. Specifically, regarding M03 (Awareness and local training events), the dedicated training will take into account the needs and gaps gathered from the survey, as well as key sectors and themes declared by users to be lacking knowledge.

7.Annexes

Annex I: Survey questions

Survey on the use of Copernicus data for the Marine sector

The marine sector faces several challenges regarding management and sustainability. It is becoming evident that the challenges linked to marine data and information availability will become even more important during the implementation of certain policies and strategies. Users from different marine sectors can use Copernicus data to extract information to determine the environmental status of coastal waters, to support sustainable development or growth in certain maritime areas and activities.

Under this context, the Framework Partnership Agreement on Copernicus User Uptake (FPCUP) aims at a better integration of Copernicus data in the European regulatory framework by increasing the number of users and applications derived from Copernicus through 3 different actions:

- Action A2021-2-33 pursues "to promote the use of Copernicus data in the implementation of the EU Marine Spatial Planning Directive (Directive 2014/89/EU; MSP) and EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD),
- Action A2021-2-42 pursues "to promote the use of Copernicus data across the maritime sector, focusing on Ports and Harbours, Aquaculture and Fisheries",
- Action A2021-2-47 pursues "to define the roadmap to guide the future evolution of Copernicus products to fulfil the needs of users in coastal areas".

The aim of this survey is to identify the current needs and gaps of the stakeholders to better understand the current usage of Copernicus data across different sectors:

- implementation of the two Directives (Action 33),
- marine sector, focusing on Ports and Harbours, Aquaculture and Fisheries (Action 42),
- national coastal users (Action 47).

By participating in this survey, you will have the opportunity to join future Copernicus training events that will be organised in the scope of the FPCUP project.

For this survey, please consider the following definitions and policies:

"Copernicus program" is the Earth Observation program of the European Union.

"Copernicus satellite data" are the data from Sentinel satellite missions (Sentinel 1, 2, 3, 5P and 6), as well as data from satellite missions of other space agencies and commercial providers, called Contributing Missions.

"Copernicus service products" are the products provided by the 6 Copernicus Services (Land, Marine, Atmosphere, Climate Change, Emergency, Security), that use satellite and in situ data as inputs.
"EU Marine Strategy Framework Directive (Directive 2008/56/EC)". This Directive establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment.

"Commission Decision (EU) 2017/848" laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment.

"EU Marine Spatial Planning Directive (Directive 2014/89/EU)". This Directive establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources.

"Water Framework Directive (Directive 2000/60/EC)". This Directive requires EU Member States to achieve good status in all bodies of surface water and groundwater by 2027.

"Habitats Directive (Directive 92/43/EEC)". This Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species.

Survey
(*in bold below was for internal reading*)

1. General information
    a. Entity
    b. Department
    c. Contact name:
    d. Email:
    e. Job position:
    f. City:
    g. Country:
    h. Type of Entity
        i. Academia
        ii. Research
        iii. Public administration
        iv. Another public entity
        v. Private sector
        vi. Non-Governmental Organization (NGO)
        vii. Other (please specify)
    i. What is your area of activity? (***Multiple choices allowed***)
        i. Inland
        ii. Coastal
        iii. Marine
    j. In terms of Copernicus Data, do you consider yourself a:
        i. End-user
        ii. Service provider
2. Which of these marine sectors are you related with? (***Multiple choices allowed***)
    a. Ports and harbours
    b. Aquaculture (shell farming)
    c. Aquaculture (fish farming)
    d. Fisheries
    e. Species conservation and protected areas
    f. Maritime transport routes and traffic flows
    g. Energy sector (hydrocarbons and renewable energies)
    h. Coastal protection
    i. Raw material extraction
    j. Tourism and recreational activities
    k. Other

3. (***If chosen "Ports and harbours" in Q2***) For the "Ports and harbours" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest) **(bold means it is a common option between marine sectors)**
    a. Maritime climate (e.g., for Operational and maintenance activities)
    b. Ship detection (e.g., monitoring vessel activity)
    c. Pollution and environmental monitoring (e.g., oil spills, water quality, air quality)
    d. Effects of climate change (e.g., sea-level rise, extreme events)
    e. Infrastructure monitoring (e.g., containers, piers)
    f. Navigation and dredging operations (e.g., bathymetric mapping, sediment dynamics)
    g. Others (specify)

4. (***If chosen "Aquaculture (shell farming)" in Q2***) For the" Aquaculture" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
    a. Oceanographic data: waves, tides (e.g., for Operational and maintenance activities)
    b. Ship detection (e.g., monitoring illegal activity)

   c. **Pollution and environmental monitoring (e.g., oil spills, microbiological contamination, chemical contamination, biotoxins)**
   d. **Effects of climate change (e.g., extreme events, marine heatwaves)**
   e. **Marine water quality data (e.g., anoxic events, acidification, chlorophyll concentration, jellyfish presence)**
   f. Infrastructure monitoring (e.g., cages)
   g. Selection of suitable site locations and species (e.g., temperature, salinity, etc)
   h. Others (specify)

5. **(If chosen "Aquaculture (fish farming)" in Q2**) For the" Aquaculture" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Oceanographic data: waves, tides (e.g., for Operational and maintenance activities)**
   b. **Marine water quality data: anoxic events, acidification, chlorophyll concentration, jellyfish presence**
   c. **Ship detection (e.g., monitoring illegal activity)**
   d. **Pollution and environmental monitoring (e.g., oil spills, microbiological contamination, chemical contamination, biotoxins)**
   e. **Effects of climate change (e.g., extreme events, marine heatwaves)**
   f. Infrastructure monitoring (e.g., cages)
   g. Selection of suitable site locations and species (e.g., water temperature, salinity, etc)
   h. Others (specify)

6. (***If chosen "Fisheries" in Q2***) For the "Fisheries" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Maritime climate (e.g., for Operational and maintenance activities)**
   b. **Ship detection (e.g., monitoring illegal activity)**
   c. **Pollution and environmental monitoring (e.g., oil spills, water quality)**
   d. **Effects of climate change (e.g., extreme events, marine heatwaves)**
   e. Fishing area characterizations (e.g., areas of higher productivity)
   f. Fisheries certification
   g. Map of sea use (e.g., presence of conflicting human activities)
   h. Others (specify)

7. (***If chosen "Species conservation and protected areas" in Q2***) For the "Species conservation and protected areas" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Pressures (e.g., pollution, spills, maritime activities…etc)**
   b. **Environmental monitoring (e.g., water quality, ecological status)**
   c. **Effects of climate change (e.g., sea-level rise, extreme events)**
   d. Habitat distribution area and trends
   e. Species distribution area and trends
   f. Map of sea use (e.g., presence of conflicting human activities)
   g. Others (specify)

8. (***If chosen "Maritime transport routes and traffic flows" in Q2***) For the "Maritime transport routes and traffic flows" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Maritime climate (e.g., for Operational and maintenance activities)**
   b. **Ship detection (e.g., monitoring vessel activity and flows)**
   c. **Pollution and environmental monitoring (e.g., oil spills, water quality)**
   d. **Effects of climate change (e.g., new routes, extreme events)**
   e. Weather services
   f. Navigation (e.g., Bathymetry, Sediment dynamics monitoring, etc.)
   g. Others (specify)

9. (***If chosen "Energy sector" in Q2***) For the "Energy sector" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

   a. **Maritime climate (e.g., for Operational and maintenance activities)**
   b. **Ship detection (e.g., monitoring vessel activity)**
   c. **Environmental monitoring (e.g., oil spills, water quality)**
   d. **Effects of climate change (e.g., sea-level rise, extreme events)**
   e. Selection of suitable renewable energy locations (wind, waves, currents)
   f. Bottom geologic maps
   g. Energy production surveying
   h. Map of sea use (e.g., presence of conflicting human activities)
   i. Others (specify)

10. (***If chosen "Coastal protection" in Q2***) For the "Coastal protection" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Maritime climate (e.g., winds, waves and current forecasts)**
   b. **Pollution and environmental monitoring (e.g., eutrophication, water quality)**
   c. **Effects of climate change (e.g., sea-level rise, extreme events)**
   d. Monitoring and prevention of coastal erosion
   e. Bathymetry and sedimentation
   f. Coastline detection
   g. Characterisation of emerged coastal areas (e.g., sediment dimension, inland extension of the beach, presence of dunes)
   h. Others (specify)

11. (***If chosen "Raw material extraction" in Q2***) For the "Raw material extraction" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Maritime climate (e.g., for Operational and maintenance activities)**
   b. **Ship detection (e.g., monitoring vessel activity)**
   c. **Pollution and environmental monitoring (e.g., oil spills, water quality)**
   d. **Effects of climate change (e.g., sea-level rise, extreme events)**
   e. Map of sea use (e.g., presence of conflicting human activities)
   f. Others (specify)

12. (***If chosen "Tourism and recreational activities" in Q2***) For the "Tourism and recreational activities" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
   a. **Maritime climate (e.g., for weather)**
   b. **Effects of climate change (e.g., sea-level rise, extreme events)**
   c. Water quality (e.g., preserving human health in bathing waters)
   d. Identification of pressures (e.g., land use, presence of urban wastewaters or industrial waters discharges)
   e. Landscape quality (e.g., absence of infrastructures, presence of nature-based solutions)
   f. Others (specify)

13. (***If chosen "Other" in Q2***) For "Other" sectors, select one of the lists below and describe which services are of higher interest to you.
   a. Military
   b. Exploration, exploitation, and extraction
   c. Scientific research
   d. Underwater cultural heritage
   e. Submarine cable and pipeline routes

Concerning the sectors mentioned above, we will analyse the challenges you have encountered when searching/working for data related with them.

14. Within the framework of your current activities, what problems do you encounter when working with the data available to you? (***Multiple choices allowed***)
   a. Complexity of the data
   b. Data format
   c. Data reliability
   d. Heterogeneous data collection methodologies
   e. Heterogeneous sources

f. Inaccessible data or unavailability of data
g. Incomplete Temporal distribution
h. Incomplete Spatial distribution
i. Unsuitable resolution
j. Lack of tools to manipulate the data.
k. Other, please specify.

15. Within the framework of your current activities, what temporal extent of the data would you need? (***Multiple choices allowed***)
    a. Real time or near real time (h)
    b. Short term forecast (day-week)
    c. Long term projections (month)
    d. Long term historical data series (years)

16. Within the framework of your current activities, what spatial resolution of the data would you need? (***Multiple choices allowed***)
    a. Reduced (>1Km)
    b. Low (>= 250 m-1Km)
    c. Medium (5-30 m)
    d. High (1-5 m)
    e. Very high (< 1 m)
17. Have you participated in the implementation of these Directives in your Country? (***Multiple choices allowed***)
    a. EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD)
    b. EU Marine Spatial Planning Directive (Directive 2014/89/EU; MSP)

18. (***If yes in Q17.b***)
    a. In what period? (***Multiple choices allowed***)
        i. 2012-2018
        ii. 2018-2024
    b. In what phase of MSP? (***Multiple choices allowed***)
        i. Establishment of management objectives
        ii. Diagnosis of the current situation
        iii. Land-sea interactions
        iv. Maritime spatial plans
19. In what period? (***Multiple choices allowed***)
    a. 2012-2018
    b. 2018-2024

20. In what phase of MSFD? (***Multiple choices allowed***)
    a. initial assessment
    b. determination of good environmental status
    c. establishment of environmental targets and associated indicators
    d. monitoring programme
    e. programme of measures

21. What Marine Region do you belong to?
    a. Baltic Sea
    b. North-east Atlantic Ocean
    c. Mediterranean Sea
    d. Black Sea

22. What subdivisions (if exist) of the Marine region do you belong to? (***Each country please specify yours***)
    a. North-Atlantic
    b. Sud-Atlantic
    c. …
    d. …
    e. …

23. Following the classification in COMMISSION DECISION (EU) 2017/848, which of the following descriptors and Criteria elements are you related with? (***Multiple choices allowed***)
    1. Biodiversity
        - Species groups (specify which):
            - birds,
            - mammals,
            - reptiles,
            - fish
            - cephalopods
        - Pelagic habitats (specify which)
        - Benthic habitats (specify which)
        - Ecosystems, including food webs (specify which)
    2. non-indigenous species
    3. Commercial fish species
    4. Food webs
        - Ecosystems, including food webs (specify which)
    5. Eutrophication
    6. Sea floor
        - Benthic habitats (specify which)
    7. Hydrographical conditions
    8. Contaminants and effects
    9. Contaminants in seafood
    10. Marine litter
    11. Introduction of energy (including underwater noise)

Concerning the descriptors/criteria mentioned above, we will analyse the challenges you have encountered when searching/working for data related with them.

24. What are the main knowledge gaps descriptors you encountered when working with the descriptor/criteria specified above? (***Multiple choices allowed***)
    a. Abundance
    b. Biomass
    c. Concentration
    d. Duration
    e. Genetics
    f. Pressures and impacts
    g. Spatial cover/ extent
    h. Spatial distribution
    i. Temporal distribution
    j. Other, please specify.

25. Within the framework of your current activities, what problems do you encounter when working with the data available to you? (***Multiple choices allowed***)
    a. Complexity of the data
    b. Data format
    c. Data reliability
    d. Heterogeneous data collection methodologies
    e. Heterogeneous sources
    f. Inaccessible data or unavailability of data
    g. Incomplete Temporal distribution
    h. Incomplete Spatial distribution
    i. Unsuitable resolution
    j. Lack of tools to manipulate the data.
    k. Other, please specify.

26. Within the framework of your current activities, what temporal extent of the data would you need? (***Multiple choices allowed***)
    a. Real time or near real time (h)
    b. Short term forecast (day-week)

c. Long term projections (month)
d. Long term historical data series (years)

27. Within the framework of your current activities, what spatial resolution of the data would you need? (***Multiple choices allowed***)
    a. Reduced (>1 Km)
    b. Low (>= 250 m - 1 Km)
    c. Medium (5-30 m)
    d. High (1-5 m)
    e. Very high (< 1 m)

28. Have you ever heard before about the Copernicus program?
    a. Yes
    b. No

29. (***If yes in Q28***) Are you familiar with the different definitions of "Copernicus Satellite Data" and "Copernicus Service Products".
    a. Yes
    b. No

30. (***If yes in Q28 go to a; If no in Q28 go to b***) Do you use data from Copernicus?
    a. If Yes
        i. How often?
            1. every week
            2. every month
            3. every year
        ii. For what purpose (i.e., use case)? (Please specify)
        iii. What kind of Copernicus data do you use?
            1. In situ data
            2. Satellite-derived products
            3. Modelled-derived products.
        iv. Do you consider yourself as a basic, intermediate, or advanced Copernicus data user?
            1. Basic
            2. Intermediate
            3. Advance
        v. What is your level of satisfaction with Copernicus? (Set from 1(low) to 5 (very high))
            1. 1
            2. 2
            3. 3
            4. 4
            5. 5
        vi. How can Copernicus data be improved (e.g., new products, different spatial/temporal resolutions, improved access)? (Please specify)

    b. If No, why?
        i. I do not have enough knowledge or skills to use them.
        ii. I do not have enough staff or time to do it.
        iii. Not relevant for me
        iv. Other

31. Within the framework of your current activities, do you use most: (***multiple choices allowed***)
    a. Programming languages (C++, Python, Java, MATLAB, etc)
    b. Mapping software (ArcGIS, MapInfo, Qis, etc)
    c. Image processing software (SNAP, Google Earth Engine, etc)
    d. Visualisation software (EO browser, etc)
    e. I do not use any.

32. Besides Copernicus data, what kind of data or services would you need? (Please specify)
33. From your entity's perspective, which space solutions (e.g., products, providers) are relevant to the maritime domain, that you are familiar with/have you heard of? (Please specify)
34. Would you be interested to attend a workshop presenting the different tools and services offered by Copernicus?
    a. Yes
    b. No

Annex II: Analysis of number of replies per sector

Matrix reporting the number of users that replied for each sector (values highlighted in blue matrix diagonal), and the number of users that had other additional sectors of preference (remaining values in the same row). As an example, 48 replied to Ports and harbours and of these 16 replied also to Aquaculture (shell farming), 12 replied also to Aquaculture (fish farming) and so on.

How many replied to multiple sectors? (Example. 44 replied Ports and harbours, of these 15 replied also Acquaculture(shell farming), 11 replied also Acquaculture(fish farming) and so on..)	Ports and harbours	Aquaculture (shell farming)	Aquaculture (fish farming)	Fisheries	Species conservation and protected areas	Maritime transport routes and traffic flows	Energy sector (hydrocarbons and renewable energies)	Coastal protection	Raw material extraction	Tourism and recreational activities	Scientific research	Military	Exploration, exploitation and extraction	Submarine cable and pipeline routes	Underwater cultural heritage
Ports and harbours	48	16	12	22	24	19	18	29	7	21	17	5	3	0	2
Aquaculture (shell farming)	16	37	26	24	23	11	12	25	7	19	14	2	5	1	0
Aquaculture (fish farming)	12	26	39	25	25	10	15	26	7	19	16	2	5	1	0
Fisheries	22	24	25	62	41	20	15	39	12	27	23	4	5	1	2
Species conservation and protected areas	24	23	25	41	84	19	24	46	15	29	35	2	5	1	3
Maritime transport routes and traffic flows	19	11	10	20	19	37	16	21	9	16	10	5	3	1	2
Energy sector (hydrocarbons and renewable energies)	18	12	15	15	24	16	40	26	9	19	17	3	2	1	3
Coastal protection	29	25	26	39	46	21	26	81	13	35	36	7	3	1	2
Raw material extraction	7	7	7	12	15	9	9	13	20	10	8	1	3	1	0
Tourism and recreational activities	21	19	19	27	29	16	19	35	10	48	25	2	5	0	2
Scientific research	17	14	16	23	35	10	17	36	8	25	72	0	0	0	0
Military	5	2	2	4	2	5	3	7	1	2	0	8	0	0	0
Exploration, exploitation and extraction	3	5	5	5	5	3	2	3	3	5	0	0	7	0	0
Submarine cable and pipeline routes	0	1	1	1	1	1	1	1	1	0	0	0	0	1	0
Underwater cultural heritage	2	0	0	2	3	2	3	2	0	2	0	0	0	0	3

Annex III: List of answers to open-ended question (Q30.vi, Q32, Q33)

How can Copernicus data be improved (Q.30.vi):

1. Different temporal and spatial resolutions.
2. Better spatial resolution.
3. Improved spatial and temporal resolution.
4. Easier data access.
5. Improved spatial resolution.
6. Greater availability of spatial resolutions below 1 km.
7. Better resolution and tutorials for better data handling and download.
8. Better resolutions (both spatial and temporal).
9. Better access.
10. Nothing. It's perfect.
11. No constant changes in access.

12. Making images available in other formats facilitates processing, e.g., TIFF and even in ASCII type.
13. Easier access to tailored products. Easier access to higher resolution services. Improved accessibility.
14. Have access to forcing data from the models (atmospheric forcing, flows, etc.).
15. Facilitate the data download strategy.
16. New products with the potential to increase the resolution of some of the available products.
17. New products, better resolutions, AI tools for more automatic processing.
18. Higher spatial resolutions.
19. User manuals for SNAP and other tools on the Copernicus platform.
20. Longer time series and better spatial resolution data for the South Atlantic.
21. New products, with spatial resolutions not yet offered by current orbital systems.
22. New products and more advanced resolutions can facilitate studies proposed by researchers.
23. Satellite products in coastal areas with improved spatial and temporal resolution.
24. Increased spatial resolution.
25. Considering our current use and future perspective, an improvement for us would be if Copernicus could have finer resolution models available for our region. It could help us because we do not have a large computational capacity, and downscaling demands several hours of processing.
26. Always good to have higher spatial resolution, especially for applications in coastal areas. Hyperspectral data and increased availability of SAR data. Also, maintaining the availability of ocean color, wind, and surface temperature data.
27. For island states like Cape Verde, the resolution of the data has to be improved because we are often working with small areas.
28. Better spatial resolutions.
29. Establishment of direct downlink for data reception.
30. Historic data availability instantly and a free platform for large data analysis and visualization.
31. Product stability and longer forecasts.
32. Download format best suited to needs, e.g., downloading the same variable from an ensemble of products.
33. Resolution.
34. Better access.
35. Better resolution for coastal processes (altimetry still very limited). Access to 3D hindcasts of numerical models to force coastal solutions or perform 3D Lagrangian diagnostics.
36. Historical time series of high-resolution 3D oceanographic models, such as IBI analysis at hourly time resolutions. In-situ wind data. Higher resolution in global products.
37. Improve the accessibility of the data (make it easier to extract). Provide more information on the different data available (how it has been obtained, the units, etc.).
38. Improve access and downloading of data.
39. Increasing the spatial and spectral resolution of the images.
40. Better access for downloading large amounts of data.
41. Providing end products with different spatial and temporal scales, particularly for work in coastal areas, requires higher resolution than most of the available products.
42. I think that in my case, I would need more personalized advice. Copernicus may have data that is more tailored to my needs, but it is difficult for me to find out how to access it.

43. Improvement of historical data. Improved catalog and ease of access.
44. Higher spatial resolution. Improve access to data to avoid relying on Google.
45. I am not an advanced enough user of Copernicus to be able to contribute much. For the management of marine protected areas, we could be interested in monitoring physio-chemical variables, such as water quality, nutrients, chlorophyll, to detect problems. As well as data sets to assess the impacts of climate change. Another possible functionality would be the possibility of detecting large cetaceans. Analysis of pressures from human activities...
46. Access and spatial resolution.
47. Although the changes in platforms like CMEMS have been extraordinary, there are still difficulties in choosing a time range or selecting parts of the time range for a particular point (using the map interface). There are few observational products compared to model products, and for certain studies, it would be interesting to have more sets of observational products. Although spatial resolution is increasing, any improvement in this area is welcome.
48. Spatial and temporal resolutions.
49. Better spatial resolution in estuarine areas.
50. More products related to anthropogenic impacts, such as pipelines, legal and illegal outfalls, FMS maritime traffic, etc.
51. Development of a more user-friendly interface.
52. At the moment, I have enough information to assimilate. It might be good to link Copernicus and EmodNet.
53. Perhaps improve spatial resolutions in coastal areas or areas of particular oceanographic interest. The same applies to temporal resolution.
54. A more intuitive use of Sentinel data would be nice.
55. Finer spatial precision (<1m) and more spectral bands.
56. Better adaptation to the coast in resolution and treatment models (atmospheric correction, chlorophyll calculation).
57. Better spatial resolutions; easier use of satellite data.

Besides Copernicus data, what kind of data or services would you need? (Q.32):

1. Training in some more specific products (e.g., SAR).
2. Wind model data.
3. In situ data, Modis data.
4. In situ data with time series of current velocities obtained in situ.
5. In situ meteorological data (observations) would be beneficial for calibration/correction of maps produced (in this case, wind maps) by SAR.
6. Detection of smaller contacts, establishment of parameterizable risk zones, and coastal monitoring and changes.
7. Monitoring the evolution of the shoreline based on high-resolution remote sensing data.
8. Benchmarks.
9. Meteo-oceanographic data in open ocean and coastal zones.
10. Forecasting rivers' flow and quality in the main coastal basins. Time series of water quality in some points to validate models.

11. In situ data from other platforms used in oceanography and data on foreign fleet catches in my sub-region in Africa.
12. Real-time geographical visualization.
13. Easily accessible national data from monitoring campaigns.
14. Maritime traffic data, plus biological/ecosystem health sampling data.
15. References to existing aquaculture facilities.
16. Updated wind data at different altitudes and accurate fishing activity data.
17. Open-access databases with a variety of marine-related data like the one developed by MITERD.
18. Some respondents believe that Copernicus data would be sufficient.
19. Agile multidisciplinary data access services.
20. Maybe estimates of LCSs (Lagrangian Coherent Structures) such as FSLEs (Finite-Size Lyapunov Exponents).
21. None.
22. In situ data (e.g., EMODNET).
23. The Biodiversity Foundation has created a GIS protocol to standardize data collected in their projects and calls for proposals to provide to the Nature Data Bank. No other specific needs identified so far.
24. Data on current stock status of commercial and recreational species of interest. Apps for reporting catch data for professional and recreational fishing. Accurate bathymetry of the coast of Cantabria from the zero level to the 50 isobath.
25. Updated orthophotographs, LIDAR mapping.
26. None.
27. Species distribution data from global databases.
28. In situ sampling data.
29. Fishing information, especially for the fleet without VMS (Vessel Monitoring System), spatial distribution of habitats, and vulnerable marine ecosystems.
30. Data from VMS.
31. Modelling data and in situ data on currents.
32. None.
33. Statistical and economic data from historical series, serving as a scientific basis for national policy-making.
34. Marine in situ data are challenging to obtain, especially bathymetry. It is crucial for Copernicus to use in situ data from countries to calibrate their products in the Mediterranean area better.
35. Data on the distribution and conservation status of marine habitats and species, as well as data on human activities and pressures affecting them. Both historical data for long-term monitoring and more frequent data to detect changes. Real-time data for monitoring compliance with regulations in management plans for sites.
36. Systematized monitoring service for the evolution of beaches, including sediments and fixed or removable installations.
37. Climate services.
38. None.
39. Tools to manage these data.
40. Data on temperature, salinity, pH, and dissolved oxygen of coastal surface waters.

41. Open cartography.
42. None.
43. Nothing more.
44. None.
45. A file manager allowing bulk downloading of data and an improved interface to make downloading easier for a more open public.
46. Complete and disaggregated maritime traffic data for each ship or vessel. Spatial distribution data and small-scale environmental data (temperature, pH, etc.).
47. Altimetry data allowing calculation of river basin flows.
48. Port water quality data.
49. None.
50. More data on marine biodiversity distribution.
51. Multispectral or hyperspectral drones.
52. In-situ species distribution data for validation.
53. EMODNET.
54. None.
55. EMODNET.
56. ECDIS (Electronic Chart Display and Information System).
57. AIS Vessel Identifier.
58. None.
59. Satellite imagery, environmental data in aquatic environment, atmospheric environmental data.
60. Detailed coastal mapping at a meter scale.

From your entity's perspective, which space solutions (e.g. products, providers) are relevant to the maritime domain, that you are familiar with/have you heard of? (Q.33):

1. I don't know.
2. Different temporal and spatial resolutions.
3. Not applicable.
4. Better spatial resolution.
5. Improvement in spatial and temporal resolution.
6. Easier data access.
7. Improvement in spatial resolution.
8. Greater availability of spatial resolutions below 1 km.
9. Better resolution and tutorials for data handling and download.
10. Not applicable.
11. Better resolutions (both spatial and temporal).
12. Better access.

13. Nothing. It's perfect.
14. No constant changes in access.
15. Making images available in other formats facilitates processing, e.g., TIFF and even in ASCII type.
16. Easier access to "Tailored" products. Access to services with higher resolution. Better accessibility.
17. Not specified.
18. Access to data for model forcing (atmospheric forcing, river discharges, etc.).
19. Facilitate the data download strategy.
20. New products with potential for increasing the resolution of some of the available products.
21. New products, better resolutions, AI tools for more automatic processing.
22. Greater spatial resolutions.
23. User manuals for SNAP and other tools on the Copernicus platform.
24. Longer time series and better spatial resolution data for the South Atlantic.
25. New products with spatial resolutions not currently offered by existing orbital systems.
26. New products and advanced resolutions can facilitate proposed studies by researchers.
27. Satellite products with better spatial and temporal resolution in coastal areas.
28. Increase in spatial resolution.
29. For island states like Cape Verde, data resolution needs improvement due to working with small areas.
30. Better spatial resolutions.
31. Establishment of direct downlink for data reception.
32. Not specified.
33. Historic data availability and a free platform for large data analysis and visualization.
34. Stability of products and longer forecasts.
35. Download format more suitable to needs, e.g., downloading the same variable from an ensemble of products.
36. Resolution.
37. Better access.
38. Better resolution for coastal processes, including access to 3D hindcasts of numerical models.
39. Historical time series of high-resolution 3D oceanographic models and in-situ wind data.
40. Higher resolution in global products.
41. Improve data accessibility and provide more information about the available data.
42. Improve access and downloading of data.
43. Increase spatial and spectral resolution of images.
44. Better access for downloading large amounts of data.
45. Provide end products with different spatial and temporal scales, particularly for work in coastal areas.
46. Better personalized advice and data tailored to individual needs.
47. Improvement of historical data and improved catalogue and ease of access.
48. Higher spatial resolution and improved access to data.

49. Not an advanced enough user to contribute much but interested in physic-chemical variables for monitoring marine protected areas.
50. Better access and spatial resolution.
51. Although improvements in platforms like CMEMS have been significant, there are still difficulties in choosing time ranges or selecting specific points in the map interface. More observational products compared to model products would be useful.
52. Spatial and temporal resolutions.
53. Better spatial resolution in estuarine areas.
54. More products related to anthropogenic impacts.
55. Development of a more user-friendly interface.
56. Satisfied with the current information assimilation.
57. Consider linking Copernicus and EmodNet.
58. Improve spatial resolutions in coastal and oceanographic areas of interest.
59. Improve the intuitive use of Sentinel data.
60. Finer spatial precision (<1m) and more spectral bands.
61. Better adaptation to coastal areas in resolution and treatment models (atmospheric correction, chlorophyll calculation).
62. Better spatial resolutions and easier use of satellite data.